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Automated Energy Distribution and Reliability System: Validation Integration – Results of Future Architecture Implementation

D.L. Buche

Northern Indiana Public Service Co.
Merrillville, Indiana

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NREL Technical Monitor: Thomas Basso
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Preface

In 1998, the Department of Energy (DOE) established the Distributed Power Program to address systems integration issues and market barriers that may prohibit the widespread deployment of distributed power technologies. Initial efforts under the program involved creating national technical interconnection standards, establishing research and development programs to address system integration technologies documenting regulatory and institutional market barriers, and working with industry and state and federal policymakers to remove barriers. At that time, the National Renewable Energy Laboratory (NREL) led these research activities for the DOE. Under this subcontract, Northern Indiana Public Service Company (NIPSCO), a NiSource, Inc. Company, has developed a modernized Automated Energy Distribution and Reliability System (AEDR) based on geographical information system (GIS) technology. This integrated geographical database serves to enhance energy supply reliability and security by improving the integrity and accessibility of location data, while fostering public safety through sharing of utility location information with authorized government entities and other organizations. This modernization of the gas & electric infrastructure helps to assure safe, reliable, and affordable service to homes and businesses.

This report is second in a series of reports required for submission. The report details the efforts undertaken to implement Phase II of the AEDR at NIPSCO and provides the interim status of the subcontract work. A future final status report will complete the documentation for this subcontract. While specific to NIPSCO's requirements, there is sufficient information to provide individuals in the initial stages of their own GIS project with a conceptual strategy, answers to some common questions and enable the re-use of some of the materials provided.

NIPSCO wishes to express sincerest gratitude for the funding assistance provided by the Department of Energy and the technical support received by the National Renewable Energy Laboratory. This project would not have been possible without their support.

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1   Introduction

Modernizing the electric-gas utility infrastructure by implementing Geographic Information System (GIS) technology, results in a number of benefits for both the utility as well as its customers. Traditionally residing partly in an AutoCAD-based system and partly in a relational database system, NIPSCO facility information (gas, electric and land) was served by distinct and not readily interoperable technologies. Thus it was time consuming and sometimes cumbersome to readily maintain the integrity of the data and disseminate facility information to those requiring it. These technical inadequacies were significantly improved by the implementation of a Geographic Information System (GIS) technology. The data was made available within a single database using consolidated and widely popular software customized to maintain and report facility information thus harmonizing interoperability among interfacing technologies.

Figure 1-1 presents the database-driven GIS solution managing all of NIPSCO's gas, electric and landbase objects and the interoperability available to the interfacing technologies.
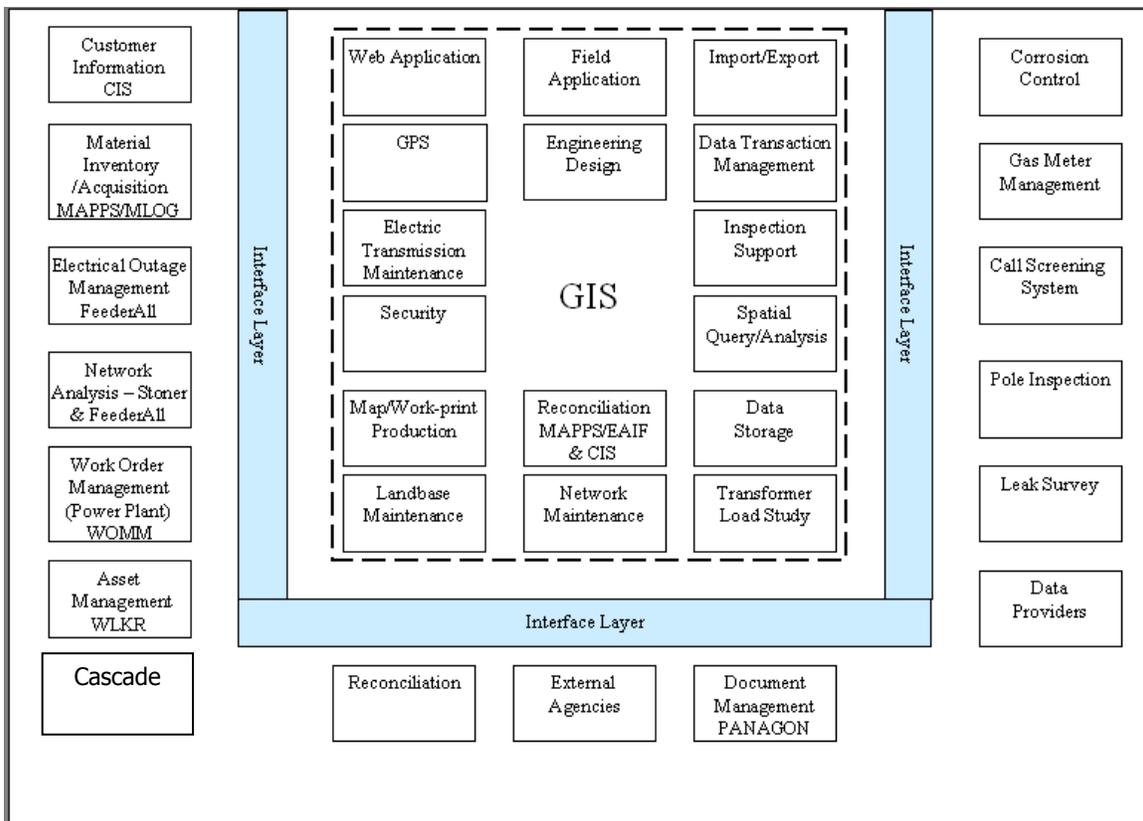
Figure 1-1. NIPSCO GIS approach to AEDR

The project was completed in two phases. This report describes the Automated Energy Distribution and Reliability system Phase II project effort and status. The focus of this report is Phase II including Task 4 Future Conceptual Architecture Implementation. The

Phase I effort is described in the Validation Integration – Results of Immediate Architecture Implementation report located on the NREL website at http://www.nrel.gov/docs/fy08osti/42265.pdf.

The focus of that report was the Preliminary Phase Tasks 1 and 2, and Phase I and Task 3, Immediate Conceptual Architecture Implementation. That report introduced and described the overall AEDR project structure, methodology, phases and the subcontract Statement of Work (SOW) consisting of seven tasks. Future reports will include the remaining Tasks governed by the Statement of Work (SOW).

This Phase II report contains the work accomplished in the year and a half since the first phase of the AEDR was implemented into production. Each section describes the new functionality, operational use, and/or the implementation of the work that had begun during the first phase of the project.

1.1 Objectives and "Unexpected Benefits"

The Phase II objectives involved implementing the "Future Conceptual Architecture." This phase of the implementation was based on the original post-implementation priorities and enhancements defined and approved by management:

- The AEDR is intended to continue to provide an integrated repository for all outside plant records data and the ability to interface to external systems in addition to new systems for related data.
- The AEDR is intended to provide a platform for the research of Alternative Energy Studies.
- The AEDR is intended to provide workflow transitioning and multiple data views (e.g. existing vs. proposed).
- The AEDR is intended to improve reconciliation efficiency by supporting design posting vs. re-digitizing.
- The AEDR is intended to continue to improve network model integrity through strict enforcement of network model/data validation rules and will provide an environment for creating additional rules.
- The AEDR is intended to provide support for compatible unit design and design estimating.
- The AEDR is intended to provide enhanced field functionality to improve data integrity.
- The AEDR is intended to provide enhanced leak/repair capability.
- The AEDR is intended to provide the additional ability to support digital photos of stations, poles, etc.
- The AEDR is intended to provide geographical information expansion to areas of NIPSCO previously unknown to this technology.

Unexpected Benefits:

- New, valuable tools with far-reaching benefits were surprising easy to develop and implement.
- New AEDR users are increasing in numbers and they are tapping into the spatial analysis capabilities of the AEDR on a large scale.
- Users are being supported in a big way by a very small support group.

2 AEDR Customizations

2.1 Overview

The development of any GIS requires customizations of varying degrees. The ESRI and Miner & Miner software, ArcGIS and ArcFM respectively provide a solid foundation on which to fully configure/customize business needs. The AEDR has been fortified with a rich variety of customizations which make this system truly user-friendly and adds to the depth of value the GIS brings to NIPSCO. Just as ESRI and Miner & Miner provide a standard data model template from which to use as a starting point, application configuration and customization opportunities are endless.

Two significant customizations; the Automated Service Request and the Gas Customer Analysis enhancements are described in detail in Sections 2.12 and 2.13 respectively in order to provide examples of how NIPSCO has customized the software to significantly benefit the business process, increase user productivity and ultimately improve customer satisfaction. Nevertheless, the tables below show at-a-glance a list of all of the customizations that NIPSCO has developed within a year and a half of the initial AEDR implementation to meet business needs and further enhance the user experience in working with the AEDR system.

2.2 Batch Suite

The AEDR batch suite provides after hours behind-the scenes processing that prepares data for the next day's activities. Here, synchronization of databases, processing of data from interfacing applications, Session Manager reporting, AEDR access rights reporting, general system cleanup and database compression take place. Table 2.2-1 provides a high-level description of the various "jobs" that are executed 7 days a week, outside of normal business hours.

Table 2.2-1. Batch suite installed on the application server.

Application/Tool	Brief Description
ReleaseSDELock	Manages the locking of versions via MVV's.
DomainSynch (Synchronization)	Duplicates ArcSDE binary domains into flat tables to allow .Net data binding in SAGE.
AssetStats	Calculates KPI statistics for capital assets, used on coordinator dashboard.
SessionReporter	Creates & emails report of outstanding sessions to Maps & Records Management (1 week, 1 month, greater than 1 month).
PermissionsReporter	Queries the database for all users assigned to various application roles. Emails an Excel spreadsheet to administrators and business users once a month for access review.
CISXYExtractor	Moves updated CIS Installed Service X/Y coordinates into the staging table to be passed back to CIS (part of the CIS location cleanup).
MAPPS_Transactions Interface	Moves daily MAPPS asset transactions from DB2 into AEDR.

MAPPS_Description Interface	Moves MAPPS SIN descriptions into AEDR (used for descriptive reporting, etc).
MLOG_Assembly Interface	Moves Assembly CU's into AEDR for real time validation via AU's.
GL_WorkOrder Interface	Moves valid work order numbers into AEDR for real time validation via AU's.
CIS_Site Interface	Moves new CIS site records from DB2 into AEDR.
CIS_Installed Service Interface	Moves new CIS IS records from DB2 into AEDR.
CIS_TransformerInstall Interface	Moves transformer install and removal data from AEDR into CIS.
CIS_DistribId Interface	Moves new pole and pad installations into CIS.
CIS_CoordinateTransfer	Moves updated Installed Service X/Y data from staging tables into the CIS.
CIS_Account	Extracts CIS account data from Site and IS tables into an easy to read table that can be joined to other classes in ArcGIS.
CIS_LifeSupport	Extracts CIS Life Support records by distribution ID to be used in reporting, real time validations, and be joined to other classes in ArcGIS.
CIS_ServiceAddress	Extracts CIS address data into an easy to read table that can be joined to other classes in ArcGIS and used for reporting purposes.
MappsSynch	Processes all new MAPPS transactions AND new GIS transactions for capital assets. Handles transfers, condemnations, issues, and returns. Reports results and bad records into tables for follow-up via the Coordinator Dashboard.
DeleteFeaturesWithNullShapes	Reviews the system for any features created with null shapes (invalid features). The application then deletes these features and emails the administrators with a list of the features that were deleted. This ensures that the electric and gas exports to other systems remain correct and without errors.
DeleteActiveAssetsMissingRelationships	The ArcFM Targets tab allows users to accidentally create active object records that are not related to a feature on the map. These records can skew asset reporting and general system results. This application locates these orphaned records, deletes them from the system, and emails the administrators and business owners giving them the details of the records that were deleted so preventative action can be taken.

ReportMaster	Generates AEDR reports: • Condemnations Needing Approval Transformer/Voltage Regulator Company Use Report • FERC Transformer/Voltage Regulator Report • Annual Transformer/Voltage Regulator & Pole Report • Annual Count of Transformers/Voltage Regulators /Capacitors • Annual Count of Transformer/Voltage Regulators by County • Transformer/Voltage Regulator/Capacitor Failure Report • Temporary & Inactive Transformer/Voltage Regulator installation report • SIN Report • In Stock Transformer/Voltage Regulator /Capacitor by LOA Report • SEC Form 10K Report, and, • Annual FERC Totals for Installed Conductor.
FileArchiver	Archives condemnation reports requiring approval by day for up to one week to support re-printing and digital access for signatures.
CondemnAssetCleanup	Ensures that if any installed assets are condemned, the install records are unrelated from any GIS features.
OnDemandReportCleanup	Removes old SAGE on Demand reports from the file storage system to avoid disk usage problems and file access time problems.
StructureConductorJoiner	Builds a non-GIS relationship table between poles/pads/pedestals and OH/UG PRI/SEC conductor info records based on spatial relationships.
StreetIntersectionCreater	Manages creating street intersection point features for all street intersections, indexed by the street names for easy searching in Field Browser, Facility Browser, and ArcView.
BatchReconcilePoster	Reconciles & Posts key system managed versions on a nightly basis.
BatchRecAndCompress	Reconciles ALL versions in the GIS, reports and emails any conflict versions to Maps & Records Management and the QAQC team. Optionally performs a programmatic compress.
ConductorLengthExtraction	This job is run once a year and it exports the length of primary conductor GIS records to an external table linked by class and object ID. This length data is then used in the creation of report EDB 5032 - SEC Form 10K.
Database (DB) Compress Script	Database (DB) Script to compress the SDE database on a nightly basis via the SDE Command Line.
DB Rebuild Indices	DB Script to rebuild indices on the GIS databases every night.
DB Job CleanoutQALog	DB Job to delete the SDE log file tables of the QA team on a nightly basis. This fixed a bug that was causing corruption problems in reconciling/posting sessions.
DB Job RemoveMappsTrans	DB Job that removes MAPPS transactions that are redundant and/or that do not need to be reviewed by Maps & Records management.

2.3 AEDR GIS Client

The GIS project team has developed a number of AutoUpdaters (small pieces of code to perform a specific function). An example of an AutoUpdater in action would be the RelatedMainOid such that when the AutoUpdater fires, it searches for a gas main that is coincident with the feature being edited and automatically establishes a feature/gas main relationship without manual user intervention.

A number of tools, reports and whole processes have been developed to simplify the number of steps or automate a lengthy process all resulting in expedited or easier interaction with the application.

The asset information, migrated from a legacy system required certain customizations in order to preserve or enhance validation rules, prevent inadvertent user errors or complete a process that was only partially completed at the time of AEDR implementation. While those partially completed processes did not affect the business function, there was a manual cleanup effort associated with the migration in which the customized tools provide the venue for the clean-up in a semi-automated fashion and at the same time help ensure the proper cleanup steps have been executed.

Table 2.3-1 provides a high-level description of the various types of tools and customizations that aid in performance at the "client" level.

**Table 2.3-1. AEDR GIS Client -
installed on all ArcGIS/ArcFM clients.**

Application/Tool	Brief Description
CopyValueToRelatedObject	Avoids clerk creating duplicate data entry by copying data from a feature or object to a related object class in a configurable manner. Data must be maintained in both locations for some interfaces, history tracking, etc.
CrossOverArc	Creates jumper features when any configured linear features cross in the GIS (not turned on as of now).
Session Manager DoNotPostSubtask	Mimics ArcFM Designer functionality by removing configured feature data from a session before a post occurs.
FieldConcatenationAU	For features that need to be symbolized on more than 3 fields, this AutoUpdater (AU) combines domain driven values into a single field (usually SymbolConfigurationCode).
LoaNumberAU	LOA is required on most features for various interfaces. This AU automates the management of this field by spatially determining which LOA the feature is within when creation and update occurs.
NetworkEdgeSplitAtTap	This AU splits existing linear networked features whenever a new linear feature is placed with the 'from' or 'to' point tapping off of the existing feature.
NormalPositionSymbolAU	This AU is used on anything that carries three

	normal position fields (switchable devices). Assesses the values and if any one of the fields show as 'open' then it updates the symbol field to show as open.
PreventDeleteIfObjectHasRelatedObjects	AU is used on all features where a related object that represents the actual asset data is maintained. This prevents the user from deleting the feature before the asset data is retired.
ReferenceFeaturesRemovalButton	Button that will delete all reference features within a selected set of features.
FeatureOffsetEditTask	Allows the clerks to easily place configured OH electric devices at a fixed distance from a pole. They click on the conductor on either side of the pole, the application measures a configured distance down the conductor from the pole and creates the feature.
UniqueDistribRefNumberAU	When a new pole/pad or primary pedestal is created, this AU checks to see if the distribution reference number has been used and prevents users from entering duplicates. This AU makes use of a non-versioned table to manage the used numbers. It also ensures that all pole numbers are padded to 8 digits with leading zeros.
FeederAllOpenPointDeleteAU	When UG conductor is deleted, this AU automatically deletes any orphaned FeederAll open points.
TransformerLeadEditTask	OH Transformers are snapped to poles. This edit task allows transformers to be placed with three clicks - pole to snap to, tap point on the OH conductor, and the angle of the transformer. A transformer lead is created between the transformer and the OH conductor to maintain connectivity.
AbandonedGasFeatures	The abandon and remove functionality was customized to allow the user to specify a work order and whether the gas feature was actually abandoned in the field or removed. The customization captures both cases in retired feature classes.
RelatedMainOid	Field AU that searches for a GasMain that is coincident with the current feature and populates the configured field with the GasMain.ObjectId to establish a relationship.
PlaceAndRelateGasMainEditTask	Allows a user to click twice to create a configured gas feature. The first click indicates the insertion point and the second click indicates the GasMain to build the relationship. Used for features which are related but not coincident with a GasMain.
RelatedOidOfClosestGasMain	Field AU that gets the object ID (OID) of the closest gas main.
CPSectionCorrosionControlNumber	Populates the DGGridNumber and CorrosionControlNumber fields based on a combination of grid spatial search and the user input CorrosionSectionNumber.
CPSectionMaintenanceTool	Tool that allows the user to select a CP Section,

	perform a CP Trace within a Gas Pressure System, and relate all protected gas mains to the CP Section.
GasMainPipeChange	Creates a PipeChange feature whenever two Gas Mains were connected that had differing diameters or material.
EmergencyValveIndicator	When a valve is marked as an emergency valve, the system automatically creates an Emergency Valve Marker feature, rotates it, and places it on the map in an ideal position.
ValveNumberAU	If a valve is an emergency valve, this AU replicates the valve number over to the emergency valve marker feature where it is then annotated.
AEDR Identify Tool	This tool operates similar to the ESRI Identify Tool but only shows ArcFM configured visible fields.
AEDR Delete Report	Provides a simple text report of feature classes and OIDs that have been deleted within the current version.
All Edits Report	Provides a detailed report of all new records, deletes, and updates in a session. It can visualize the edits on a map, flash, zoom to, show attributes, automatically run the ArcFM QAQC export to a text file, and more. Used by the QAQC team.
AEDR Non-Locking Reconcile	Allows the QA user to perform a "non-locking" reconcile against SDE.Default. This allows more than one QA user to reconcile at the same time and is used in conjunction with the AEDR batch reconciliation and post tools.
AEDR Approve Session for BRP	Allows a user to call the subtask to approve a session and move it into the AEDR batch reconciliation & post queue where it will be auto reconciled and posted.
RegulatorStationArcFMQARule	Ensures that the upstream gas main object ID is populated with a valid gas main.
CIS Service Request Automation (see Section 2.12 for details)	Allows clerks to import CIS data into the GIS creating a physical location for the CIS installed service. Then allows clerks to create the service request documentation within the AEDR GIS system. The service request can then be transferred to engineering for design within an ArcView session. The engineer then returns the digital design back to the clerk for as-built updates. After as-built updates, the service request is exported into a PDF format, linked to the installed service feature in AEDR, and linked into the Gas Service Request web viewer (which is an extension of Facility Browser).
Structure Span Length Label Tool	This tool allows the engineers to select poles, pads, and pedestals and then to create labels on the map showing the field work order distance between the locations. This data is maintained in a standalone table that is managed via SAGE. Allowing the users to view the data graphically

	adds a great deal of value.
Session Manager ApprovalHistorySubtask	Custom subtask that writes an additional history entry capturing the time and details of when a session was approved/posted. This information is then copied to the completed session tables and used for clerk performance analysis as noted in the SAGE application.
Session Manager CompletedSessionSubtask	Custom subtask that copies all core session data and session history to custom session completed tables. These tables capture the past history of a completed session and are used by the clerk performance analysis as noted in the SAGE application.
Session Manager DeleteNullGasMainsSubtask	Gas main records were being created in AEDR that had NULL values for all fields including the shape. This subtask fires on the ArcFM reconcile event and checks the session for these null gas mains, selects them for user inspection, and ultimately deletes them from the session. This assisted the GIS team in figuring out how these records were being created.
Session Manager ApproveSessionForBRPSubtask	Marks a session as approved and updates the session state to be Pending Post. This then triggers the BRP process to auto reconcile and post the session.
Session Manager AutoSubmitSessionForPostSubtask	Subtask that checks the session type upon "submit for approval". If session type matches configuration, the session is auto-approved and submitted to the BRP queue (pending post state) bypassing the QA users. This is initially used for CIS service request sessions which do not need to be QA checked.
Session Manager RejectSessionBRPConflictsSubtask	Subtask that transitions the state of a session back to BRP conflicts and assigns it to the last user who worked on it to review the conflicts and resubmit the session.
CustomStructureRelate (VB6)	The ArcFM structure relate uses a box instead of a circle when calculating the structure relate distance. This excluded areas that were needed to capture for devices so the product code was enhanced to extend to a larger distance for devices.
CustomSubstationStructureRelate (VB6)	The ArcFM structure relate uses a box instead of a circle when calculating the structure relate distance. This excluded areas that we needed to capture for substation breaker to substation relationships so the product code was enhanced to extend to a larger distance for this case.
AEDR Standard ArcFM AutoText	The following standard (geographic) ArcFM Autotext elements have been created: County, GridCd, LOA, MapGridMiscData, Municipality, TaxUnit, Township.
AEDR CIS ArcFM AutoText	The following CIS ArcFM Autotext elements have been created: DevelopmentName, CustomerName,

	ServiceRequestType, LotNumber, SiteAddress, SiteId, TaxUnit.
ArcFM Display Namers for Asset Records	Display Namers were created for transformer, regulator and capacitor install, removal, and stock records. They display pertinent information including company number, transaction date, and other data (install phase, removal reason code, stock storeroom number).
ArcFM / ArcGIS Login	Re-works the ArcFM connection string to use windows authentication. This allows the user to bypass logging in to the GIS. Once the user double-clicks ArcMap, the application starts up immediately and is automatically logged into ArcFM based on configured server, service, and database parameters and permissions.
PX Session Manager Login	Re-works the PX connection string to use windows authentication. This allows the user to bypass logging in to Session Manager. Once the user double-clicks ArcMap, the application starts up immediately and is automatically logged into ArcFM. The user can then launch Session Manager without any additional authentication.
Gas Customer Analysis (See Section 2.13 for details)	Allows a gas operations technician to select a set of gas mains that are included in an outage (or for any other reason) and to automatically create buffers around the selected pipes which then allow them to locate CIS customers within the buffer. The list can also be manually updated and provides a search against CIS for any missing customers. Finally the technician can export a master list of the customers into MS Excel and then create the actual field Gas Outage / Re-light forms in MS Excel all with the click of a few buttons.
AssetInstallation	Performs custom actions for transformer, regulator and capacitor installations. Ensures that only the most recent install record can be related to a GIS feature (transformers, regulators and capacitors can have multiple installs - all of which are available in the system).
AssetRemoval	Performs custom actions for transformer and regulator removal (which consists of un-relating a unit install record from a feature).
CancelWOMOValidation	Turns off and on the WO/MO validation in cases where data is being duplicated by the system.
CapacitorRemoval	Performs custom actions for capacitor removal (which consists of un-relating a unit install record from a feature).
DeleteAttachedTransformerLead	When an OH Transformer is deleted, this ensures that any connected TransformerLeads are deleted as well.
PreventDeletionIfRelatedAssets	Prevents the deletion of a pole/pad/pedestal if they have related (configured) assets including devices, services, life support, etc.
PreventRetirementIfRelatedAssets	Prevents the retirement of a pole/pad/pedestal if

	they have related (configured) assets including devices, services, life support, etc.
PreventRelationshipDeletion	Prevents the users from accidentally deleting relationships that are purely managed by the application components (i.e. unrelating a unit install from the unit).
PreventUnrelateOfActiveAssets	Prevents the user from unrelating an active asset (object) record from a feature. This requires the user to use the EDFS retire functionality thus ensuring that the asset record is maintained correctly. Without this enforcement, users were inadvertently creating orphaned asset records.
PreventTransformerRemovalIfServCondPresent	Prevents the user from removing a transformer in AEDR if the related pole/pad has a LOAD service conductor related to it. This forces the user to transfer or remove the service conductor before removing the transformer that feeds the service.
ReplicateRetirementData	Configured for various asset objects. Allows them to traverse relationships to features or other objects to get history data at the time of retirement. For example an electric object often gets the current FeederID from the parent feature.
ReplicateSinKva	When a relationship between a transformer/voltage regulator unit and the stores item table is updated, this replicates the KVA from the SIN table up to any unit install records so that it can be used by the ArcFM KVA calculations.
ReplicateSpatialData	Configured for various asset objects. Allows them to traverse spatial relationships to features to get history data at the time of retirement. For example a conductor info record gets the "from" and "to" pole numbers nearest the end points of its parent conductor feature.
ResetAssetToInstalled	Administrator function to allow a transformer/voltage regulator/capacitor to be set back to installed if it was mistakenly removed from service.
ResetAssetToStock	Administrator function to allow a transformer/voltage regulator/capacitor to be set back to stock if it was mistakenly installed.
SupportStructureRetirement	Manages the retirement of key related assets to a pole - assemblies and joint use attachments, etc.
UpdateSinKVA	When a relationship between a transformer/voltage regulator unit and the stores item table is updated, this replicates the KVA from the SIN table up to any unit install records so that it can be used by the ArcFM KVA calculations.
ValidateAssemblyNumber	When a new assembly is added, this validates that the Assembly number is a valid MLOG number.

ValidateConductorProperties	AEDR has a table of allowed combinations of wire type, size, and material per OH/UG, Primary/Secondary/Service. This validation ensures the user enters a valid combination of these fields for the specific type of record.
ValidateReferencedAssembly	When a new company streetlight is entered, it references the mounting assembly that is used. This ensures that the assembly already exists on the pole and is available in the correct quantity.
ValidateWorkOrderNumber	Handles validation of WO/MO format and then validates the work order against the GL table to ensure it exists.
RetireLegacyConductorInfo	Allows the user to search the legacy EDFS conductor tables for any records matching a selected conductor feature. If found, the records can be easily moved from active to retired.
MigrateAndDeleteConductorInfo	Allows the user to search the legacy EDFS conductor tables for any records matching a selected conductor feature. If found, the records can be easily migrated into ArcFM Conductor Info records (related to the selected conductor) and deleted from the legacy table.
RetireOhUgCondInfoTreeTool	Fires the EDFS retirement of OH/UG conductor info which includes spatial and relationship traverses to capture related data - subtype retirement.
RetireSecondaryCondInfoTreeTool	Fires the EDFS retirement of secondary conductor info which includes spatial and relationship traverses to capture related data - subtype retirement.
RetireSectReclUnitTreeTool	Fires the EDFS retirement of recloser and sectionalizer units which includes relationship traverses to capture related data - subtype retirement.
RetireServiceConductorInfoTreeTool	Fires the EDFS retirement of service conductor records which includes relationship traverses to capture related data - subtype retirement.
RetireStrlightSwAssmblyTreeTool	Fires the EDFS retirement of streetlight switch and assembly records which includes relationship traverses to capture related data - subtype retirement.
RetireStructureTreeTool	Fires the EDFS retirement of pole/pad/pedestal features which includes relationship traverses to capture related data - object class retirement.
RetireSwitchFuseUnitTreeTool	Fires the EDFS retirement of switch and fuse units which includes relationship traverses to capture related data - subtype retirement.
RetireSwitchGearTreeTool	Fires the EDFS retirement of switch gear features which includes relationship traverses to capture related data - object class retirement.
StructureReplaceCommand	Allows user to replace an installed pole or pad. This retires the structure and creates a new identical structure while maintaining all relationships to devices, services, etc.

2.4 AEDR Citrix Application Management

NIPSCO uses a variety of ESRI/M&M applications requiring a customized application to manage the licensing. Table 2.4-1 describes at a high level the purpose for ArcLauncher.

Table 2.4-1. AEDR Citrix application management - installed on all AEDR Citrix servers.

Application/Tool	Brief Description
ArcLauncher	ArcLauncher allows for the same ArcMap, ArcCatalog, etc. executables to be published with differing licensing options. From ESRI it supports ArcInfo, ArcEditor, and ArcView combined with M&M ArcFM and ArcFM Viewer. This application sets the necessary environment variable for ESRI licensing and then updates the appropriate registry entries to control the licensing for M&M. Then it launches the application. It is a command line application that accepts parameters to determine the options and applications.

2.5 SAGE

NIPSCO integrated the legacy asset management application and data into the AEDR system. Installed on a central IIS Web Server, the custom application, Standalone Geodatabase Editor (SAGE) was necessary to track, manage and report the asset data in the new AEDR system. This stand alone application was created in part, for users that did not require a licensed version of ArcMap, i.e. they did not require spatial data information but needed to view or input tabular data only. SAGE is also a management tool that reports on user performance, and provides a security component at the application level.

Table 2.5-1 describes at a high level the custom functionality built within SAGE.

Table 2.5-1. SAGE - Manages assets without the need for additional licensing.

Application/Tool	Brief Description
SAGE Home Page	The standard home page informs the user of their current SAGE role and the permissions it includes.
Transformer/Voltage Regulator/Capacitor Add New	Allows the central storerooms to add newly purchased assets into the system including manufacturer and warranty data.
Transformer/Voltage Regulator/Capacitor Edit Existing	Allows the central storeroom clerks to update core manufacturer and warranty data as well as to enter function and oil test data.
Transformer/Voltage Regulator/Capacitor Install	Allows a record clerk to enter the installation information from a ticket. This is performed before work prints are returned from the field and captures all key tabular data about the installation.
Transformer/Voltage Regulator/Capacitor	Allows a record clerk to remove assets that are

Removal	currently installed but are not related to a GIS feature. This occurs regularly in company use / substation installations. Assets that ARE related to a GIS feature are removed within the GIS.
Transformer/Voltage Regulator/Capacitor Delete	Allows the central storeroom clerks to remove all asset data from AEDR if an asset was entered in error.
Transformer/Voltage Regulator/Capacitor Property Transfer	Allows an administrator clerk to transfer installed assets from one department (LOA), tax district, etc to another. This happens when district boundary lines are updated, re-organized, etc.
Transformer/Voltage Regulator/Capacitor Query by CN/Serial	Allows all users to query for assets based on the company number (CN) and/or serial number.
Transformer/Voltage Regulator/Capacitor Query by Location	Allows all users to query for assets based on the pole/pad number or company use location ID.
Transformer/Voltage Regulator Status	Allows a record clerk to view the entire life cycle of an asset. This is also where Condemnations, Reverse-Condemnations, Sales, and Leases are entered.
Transformer Replace	Allows a record clerk to replace an existing transformer with a new transformer. The first transformer is removed back into stock and the new transformer is installed and updated with all properties and relationships of the original transformer.
Structure Span Lengths Add/Edit/Delete	Allows a record clerk to manage the captured work order lengths between any two structures (poles/pads/pedestals/terminals) in the field. This allows AEDR to track actual distances between structures outside of the conductor features which are often drawn as super spans.
Structure Span Lengths Query	Allows all users to query the structure span lengths by querying on any structure ID.
Session Inquiry Report	Allows an administrator user to dynamically create a session manager query to display a report on a group of sessions by user/dates, status, etc. It is considered an on Demand report because it is generated based on user input values.
Posted Sessions By Week Report	Allows a user to generate a report on any given week to determine how many GIS sessions were approved and posted to DEFAULT.
Capital Assets for Sale Report	Allows a business group within NIPSCO to generate a specific formatted report on company numbers of assets that will be potentially sold to other utilities/organizations. The report accepts up to 500 company numbers at once and the resulting report can be dumped into MS Excel very easily. It is considered an on Demand report because it is generated based on user input values.
Rated KVA By Circuit Report	Allows users to report on the summed transformer KVA values by phase by circuit (filtered by substation).
Pole / Pad Mounting Inquiry Report	Allows all users to run a pole/pad card report which presents a comprehensive view of all the details of a pole/pad/pedestal including all related conductor,

	devices, services, CIS records, etc. This report is used heavily throughout NIPSCO. It is considered an on Demand report because it is generated based on user input values.
Multi Pole / Pad Mounting Inquiry Report	Allows the user to run the above Pole/Pad Mounting Inquiry report for up to 100 pole/pad/pedestal numbers. The report is generated in a web browser or alternatively can be zipped up and attached to an email that is sent to the user-specified address.
Padmount Inspection Form Report	Allows all users to query the system for all padmounted transformers or switchgears based on grid information and device size. The report returns a formatted ready to print template for field inspections of all of these devices. It is considered an on Demand report because it is generated based on user input values.
Batch Reports	Allows all users to view the batch reports: • Condemnations Needing Approval (including archives) • Transformer/Voltage Regulator Company Use Report • FERC Transformer/Voltage Regulator Report • Annual Transformer/Voltage Regulator & Pole Report • Annual Count of Transformers/Voltage Regulators/Capacitors • Annual Count of Transformers/Voltage Regulators by County Transformer/Voltage Regulator/Capacitor Failure Report • Temporary & Inactive Transformer/Voltage Regulator installation report • SIN Report • In Stock Transformer/Voltage Regulator/Capacitor by LOA Report • SEC Form 10K Report • Annual FERC Totals for Installed Primary Conductor.
Coordinator Dashboard	• Viewing of KPI capital asset statistics • View details of MAPPS/AEDR Synch (transfers, condemns, issues, returns) • Allows management viewing of outstanding MAPPS/AEDR Synch transactions • Allows querying of processed MAPPS/AEDR Synch transactions
Interactive Clerk Performance Analysis	Allows an administrator user to run interactive analysis on the performance of an individual clerk. The user chooses a clerk and a time period (week, month, quarter, year, etc.) and runs the analysis. The results contain the number of session worked during the time period, the percentage of session type (electric, gas, land), the number of QA/QC rejections, the average time worked per session, a calculated KPI, and a detail section of all completed

	sessions utilized in the analysis.
SAGE Security Management	Provides a comprehensive view of all SAGE users, their assigned role, etc.
Add New SAGE User	Allows an administrator user to add a new SAGE user account, to specify the permissions role, and specify which LOAs the user is authorized within.
Manage SAGE Roles	Allows an administrator user to add, update, and delete SAGE system roles. A role contains a defined list of SAGE permissions. Several system roles exist as well including Coordinator, Record Clerk, Stores Clerk, Query User, etc.
Reassign Service Requests - Clerk	Allows the user to reassign service requests between the clerk users.
Reassign Service Requests - Engineer	Allows the user to reassign service requests between the engineer users.
Unique Distribution Reference Administrator	Allows the user to reassign service requests between the engineer users.
Reset Condemnations	If a problem with a printer is encountered or a user is not able to print a condemnation report for approval signatures, the condemnations can be reset so they will be added to the report again on the next nights run. This report accepts a date and condemnation number parameters.
Repair SDE Lock Error	ESRI MVV's are used for the SAGE application. In the past, there have been issues where a MVV version becomes locked by the system. This functionality runs the administrator code to unlock a locked version.
SAGE Help	A Link to the online AEDR Help system as defined below.

2.6 Field Browser

To assist Field Operations, NIPSCO developed the "Field Browser", a "disconnected" laptop application designed to support field crews with the ability to view the contents of the GIS. The back office users also found the Field Browser a useful tool when working offsite and some found it useful for quick, uncomplicated queries. Consequently, Field Browser has been installed on two hundred fifty disconnected field laptops and one hundred seventy-eight back office computers. Table 2.6-1 describes the customizations provided to enhance the user experience.

Table 2.6-1. Field Browser – Customization features for use on disconnected laptops.

Application/Tool	Brief Description
ArcReader	ArcReader is used with a custom AEDR PMF file to distribute configured GIS data into personal GDB's.
AddIntersectionToStreetIntersections	The back office GIS systems allow the users to query for street centerline intersections based off of two street name fields. Because the Out-of-the-Box ArcReader only allows searching features on one field at a time, this custom windows application was developed. It adds a

Application/Tool	Brief Description
	new field to the StreetCenterlineIntersection table in a personal geodatabase and then populates the field with concatenated intersection data. It is used once a month when the field browser data is updated.
pGDBFieldStripper	To minimize the size of the personal geodatabase (pGDB) files deployed to the field units with the field browser, many back office fields are stripped out. This is a MS Windows application that allows the application administrator to create configured 'strip' files that can then be repeatedly applied to pGDB's generated from the back office GIS. This makes the process of extracting GIS data for the field browser significantly faster and automates the stripping of the pGDBs.
Circuit Isolation	Storm restoration processes are managed by substation and circuit. In order for the Field Browser to be used effectively in storm damage restoration conditions, the data is required to be displayed in an isolated mode, allowing the end-user to see the extent and control points of each individual circuit for a quick analysis of scope, location and isolation devices. Additional PMF files based on a definition by circuit of all the electric network features that carry the Feeder ID field were developed to accommodate the isolated mode functionality.

2.7 Facility Browser

Just as the Field Operations and many back office users found AEDR Field Browser to accommodate their needs, over four hundred back office users appreciate the additional functionality and near real-time currency that the network-connected AEDR Facility Browser provides. Facility Browser is installed on a central IIS/ArcIMS web server. Table 2.7-1 lists the customizations that enhance the Facility Browser application.

**Table 2.7-1. Describes the tools
To maintain the Facility Browser
application and data.**

Application/Tool	Brief Description
Database Restore Scripts	SQL Server database scripts have been developed to take a backup of the production database, add all necessary Facility Browser views, and then redeploy the data to the AEDR Facility Browser ArcSDE server. This occurs nightly in production.
Domain Synchronization	Some functionality has been put in place to allow the Facility Browser application to utilize domain description values even though ArcIMS only natively supports the domain coded

	values.
Custom ArcIMS Website	A custom ArcIMS website was created to allow for custom AEDR searches, etc.
Gas Service Card Viewer	Facility Browser includes the ability to search for Gas Service Cards based on customer information. The scanned service cards can then also be loaded via the web.

2.8 AEDR Online Help

A centralized online Help System has made user supporting documentation easy to maintain and distribute. The AEDR Online Help System is installed on a central IIS web server. Table 2.8-1 describes the technology running the AEDR Online Help System.

Table 2.8-1. Online Help.

Application/Tool	Brief Description
HTML - CHM Style Help	The help system contains all standard CHM functionality including full text search, index, table of contents, and favorites, all served via web html, javascript, and http. The centralized intranet-based Help System allows updates and additions to the Help System application to enable easy distribution to the entire organization.
Online Help Creation and Management	Custom ASP.Net Application that allows admin users to create, update, and manage online help files as well as the index, table of contents, and full text searching.

2.9 Gas DataPrep

Gas DataPrep was designed to replace Advantica's DataPrep extraction process and is installed on two clients in the NIPSCO Gas System Engineering group. Table 2.9-1 identifies the customization.

Table 2.9-1. Gas DataPrep, an Advantica SynerGEE replacement data extract.

Application/Tool	Brief Description
Gas DataPrep Extension to ArcMap	The Gas DataPrep Extension is a custom ArcMap Extension created using C#.net and ArcObjects. The extension replaces Advantica's "DataPrep" application and exports pipe, valve and regulator stations features and attributes to a set of comma delimited text files. These text files are specifically formatted to be compatible with the Advantica Middle Link product. Middle Link reads the text files to prepare the data for use in Advantica's SynerGEE application.

2.10 CADOPS/FeederAll Export (Network Adapter)

The CADOPS/FeederAll Export is installed on administrator ArcGIS/ArcFM clients and serves to export circuit data from the AEDR GIS to interfacing files for NIPSCO's Outage Restoration System. Table 2.10-1 describes the customization.

Table 2.10-1. Network Adapter.

Application/Tool	Brief Description
Custom Network Adapter	M&M's Network Adapter was customized to export a custom view of the AEDR electric networks. A custom XSLT transformation was also written to format the exported data into the appropriate ABB format for both CADOPS and FeederAll.

2.11 Windows Services

Real-time or near real-time online applications; Windows Services, have been developed and installed on servers as shown in Table 2.11-1.

Table 2.11-1. Services running in the background provide transparent processing benefits to the user.

Application/Tool	Brief Description
MAPPS - Real time Asset Push Windows Service	When capital assets (transformers, regulators, capacitors) are created, updated, or deleted in SAGE, copies of these transactions are written to the MAPPS Asset Push Queue table in SQL Server. This windows service is installed on the application server and polls this table every 15 minutes. When transactions are found, it attempts to push them into MAPPS DB2. This was written as a queued model with a windows service because DB2 Connect is not reliable enough to engage in a synchronous operation.
SAGE MVV Manager Windows Service	The SAGE website uses a single database connection string which connects it to a single ESRI multi-versioned view. When multiple users attempt to access the database at the same time, there can be locking problems at the version level (state IDs). To avoid this issue, SAGE writes all insert, update, and delete SQL statements to a multi-versioned view (MVV) Queue table and notifies the windows service by writing a SAGE Update (.sgu) file on the web server. The MVV Manager Web Service is installed on the web server and monitors a configured directory for

	.sgu files. When notified, the service processes all SQL statements in the queue table against the MVV. With this in place, there is only one process that updates the MVV which ensures there are never any locking issues.
AEDR Batch Reconciliation & Post	When multiple QA/QC users attempt to reconcile and post sessions at the same time, they will constantly run into lock conflicts that force them to work in a manual queue. This creates a major loss in efficiency. The AEDR Batch Reconciliation & Post utilizes the M&M process framework to allow QA/QC users to approve and submit sessions to an automated posting queue. The windows service then runs every half hour reconciling and posting all sessions in the queue. The service then moves the session details into AEDR history tables and then cleans the session out of the system. Finally, the service reconciles the posted changes down into all other pending approval and in progress sessions that are not in use at the time. These combined steps provide for a very efficient work flow that allows the QA/QC users to QA more sessions than before. It also maintains the health of the overall system by minimizing the outstanding versions in the database which is directly tied to performance.

The aforementioned customizations have been installed into production at varying intervals since the initial implementation of the AEDR system in June 2006. These customizations and have had a profound impact on nearly every AEDR user in that performance has improved not only from an application standpoint, but also the added functionality has increased user productivity. Upgrades and patches to the base software further contributed to the positive impact. As previously mentioned, the following two sections provide greater insight into two specific customizations, the Automated Service Request Process and the Gas Customer Analysis tool.

2.12 Automated Service Request Process

2.12.1   Overview

This section describes how NIPSCO's Gas and Electric Service Request workflow and functionality was integrated into the new AEDR ArcGIS/ArcFM environment. This implementation was accomplished with a blend of data model updates, customization to ArcFM, and additions to the AEDR GIS Client software. The goals of this implementation included both the replacement of the legacy AutoCAD Service Card functionality as well as the enhancement of the technology to provide a more efficient and effective solution for all concerned users of the system.

The objectives were to create functionality in the new AEDR ArcGIS/ArcFM system to satisfy all business needs relative to the current CIS Service Request functionality:

- Definition of new Service Request workflow.
- Creation of new CIS Installed Service Points as features in the GIS.
- Addition of a new ArcFM Page Template that will facilitate the creation of new Service Cards.
- Creation of new ArcFM Autotext elements to populate all available information on the new ArcFM Page Template.
- Create an ArcFM Stored Display that utilizes labeling so road names, circuit #, pipe size, pipe type, etc will display when zoomed into a service location.
- Creation of a storage strategy to manage all in-process Service Cards as ArcFM Stored Documents.
- Creation of storage strategy to manage completed Service Cards as Adobe PDF files.
- Use of ESRI attribute hyperlinks to link CIS Installed Service Features to the new completed Service Cards (PDF files).
- Use of ESRI attribute hyperlinks to link to all legacy Service Cards stored as TIF files.

2.12.2   Workflow

Figure 2.12-1 shows the proposed workflow for AEDR CIS Service Cards:
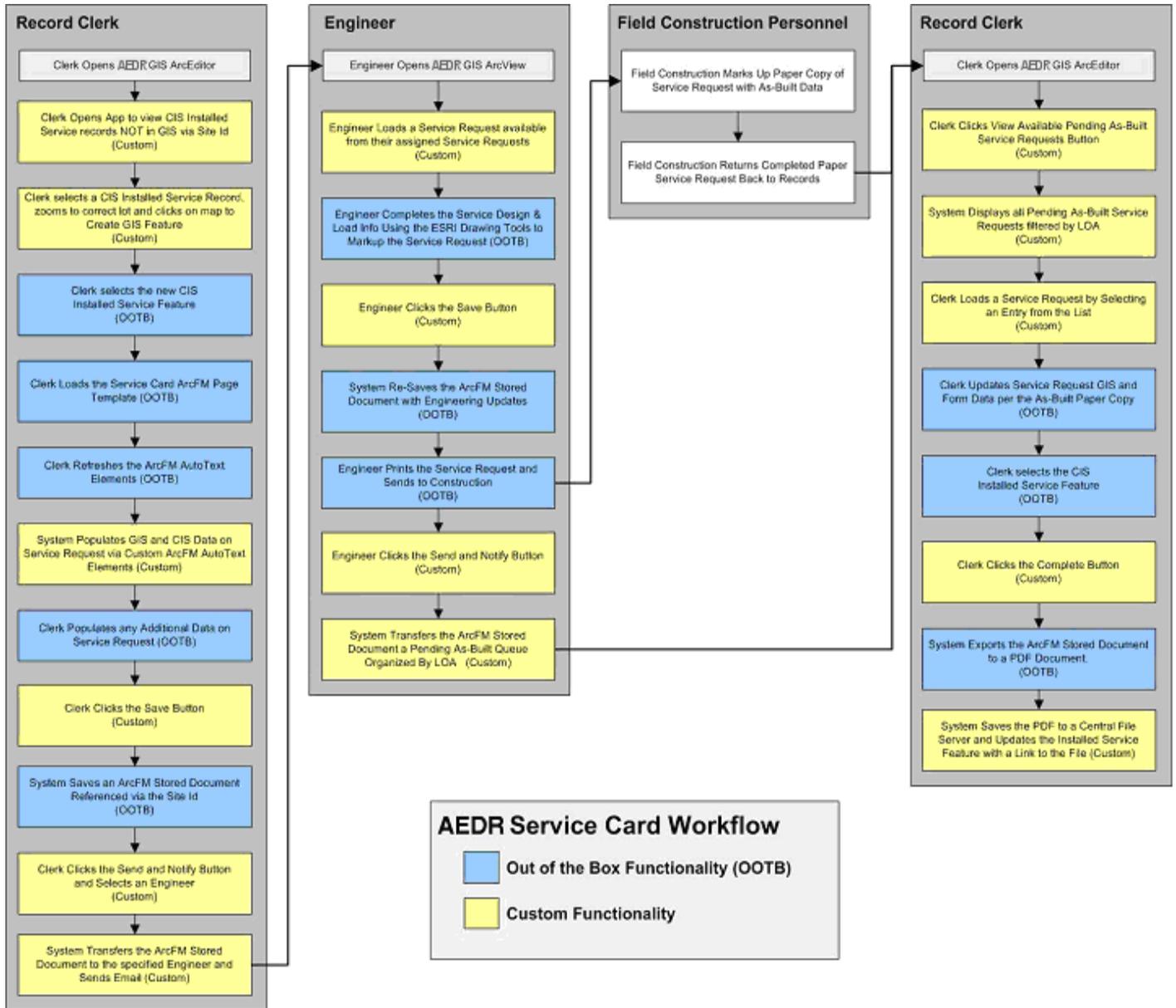
Figure 2.12-1. Automated Service Request workflow diagram.

2.12.3 Data Model Updates

Two minor data model updates were made to the AEDR system to support the implementation of the new service request functionality. These changes are detailed below.

2.12.3.1 Update arcfm8.CIS.CisInstalledService

CisInstalledService is a feature class that is used to spatially represent the installed service points sent from CIS to GIS on a nightly basis. New functionality defined in the sections below includes the ability to use ESRI hyperlinks to link CisInstalledService features to their respective service request images. To accomplish this, a new field was added to this class to allow for the storage of the file link. With this link in place ESRI was configured to utilize the values in this field to allow single-click viewing of the referenced files. The new field is defined as follows:

ServiceRequestLink varchar(250)

This field was easily added to the versioned feature class while in production without any impact to ongoing work. Use of this field is further defined in later sections of this document.

2.12.3.2 New Table arcfm8.CIS.ServiceRequestEngineers

The new service request functionality allows for the seamless transferring of in-progress service requests between clerks operating in ArcEditor and engineers working in ArcView. Part of the workflow calls for the service requests to be assigned to a specific clerk or engineer. And in the case of an assignment to an engineer, an email notification is generated to inform the engineer of the new service request. The assignment of service requests to *clerks* is available using the session manager infrastructure available in AEDR today. However, there was no location where engineering contact information exists within AEDR. To facilitate the new functionality a new table, ServiceRequestEngineers, was created within the AEDR schema. The new table contains the following fields:

ObjectId int – ESRI System Id
UserName varchar(10) – Engineer's NiSource Network ID (i.e. NA\#xxxxxx)
DisplayName varchar(50) – Engineer's First and Last Name
Email varchar(50) – Engineer's Email Address

This table is registered with the AEDR geodatabase to allow for easy access via the custom ArcObjects application(s) described in the following sections. This table is not versioned. Managing this information in a database table allows the GIS team to easily manage the addition or removal of engineers as required over time. This table was added to the geodatabase while in production without any impact to ongoing work.

2.12.4 Custom Functionality

2.12.4.1 Create CIS Installed Service Points

A new button was added to the AEDR main toolbar. The clerk clicks this button to launch a simple windows form that allows the clerk to search for pending installed service records that have been passed from CIS into GIS. See Figure 2.12-2.

Figure 2.12-2. Dialog box to search for pending installs.

The clerk inputs the Site ID and clicks the "Search for Pending CIS Records" button. The details of any pending CIS installed service records are displayed in the data grid. If records are found, the clerk can click the "Zoom to Approximate Area" button. The system will attempt to use data from the CIS such as pole/pad number or grid code (if available) to zoom the map to an approximate location. Alternatively, the user can click the "Geocode Address" button and the program will call the ESRI ArcWeb Services TeleAtlas geocoding web service with the address information to try to get a spatial match on either the address or the street. If no spatial reference data from the CIS is available, the system will inform the user. The user will then be required to manually zoom to the correct location.

Once in the right location, the clerk will highlight one or more of the CIS records in the data grid and then click the "Set X/Y" button. This will engage ArcMap and allow the user to click on the map to set the location for the new installed service point features. The corresponding X/Y values will then be displayed in a field in the grid. Each record can have the same X/Y coordinates or differing X/Y coordinates. The user may also only set the X/Y coordinates for a subset of the records displayed. Once complete, the user will then click the "Create Features" button. The system will create the new CIS Installed Service Point(s) on the map at the specified location(s) and the form will close.

2.12.4.2   Custom ArcFM AutoText Elements

ArcFM AutoText Elements will be used to auto-populate much of the data on the service request. Figure 2.12-3 shows the AutoText Elements that will be used on the service request.

Figure 2.12-3. Service request form.

Table 2.12-1. Defines the AutoText elements and their sources.

AutoText Element	Source Table	Source Field(s)	Notes
AEDR CIS IS SR Type	CISInstalledService	UtilityTypeCd	Pulled from a selected IS feature. NOTE: This is not represented on the above image due to the size. Its purpose will be to automatically check the GAS

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			[XX] or ELEC [XX] check boxes at the top of the form.
AEDR CIS Site ID	CISInstalledService	SiteId	Pulled from a selected IS feature.
AEDR CIS IS Customer	CISInstalledService	CustomerFirstName CustomerMiddleInitial CustomerLastName	Pulled from a selected IS feature. This data is not populated until the "Released to construction milestone" is completed. Therefore, when the clerk initially creates the Service Request, this will be blank. However, the engineer can update the AutoText later on in the process once the "Released to construction milestone" has occurred. If the information is available at that time, it will be displayed.
AEDR CIS Site Address	CISSite	AddrStreetNumber AddrBldgNumber AddrRuralRouteNumber AddrFractionText AddrStreetPrefix AddrStreetName AddrStreetSuffix AddrApartmentNumber AddrSuiteNumber AddrBoxNumber	Pulled from Site record related to a selected IS feature.
AEDR CIS Site Phone #	None	None	This information is not currently passed from CIS to GIS and therefore this field is manually populated by the clerks.
AEDR Municipality Name	Municipality	MunicipalityName	This AutoText Already Exists
AEDR County Name	County	CountyName	This AutoText Already Exists
AEDR Township Name	PoliticalTownship	TownshipName	This AutoText Already Exists
AEDR Taxing Unit	CisSite	TaxUnitCode	Pulled from Site record related to a selected IS feature. NOTE: This will likely be updated to use the Tax Unit polygons once they are available in the GIS.
AEDR Grid Cd	MinorGrid	MajorGridNumber PLSSSectionNumber MinorGridNumber	This AutoText Already Exists.
AEDR CIS Site Development Name	CISSite	DevelopmentName	Pulled from Site record related to a selected IS feature.

AEDR CIS Site Lot #	CISSite	AddrLotNum	Pulled from Site record related to a selected IS feature.
AEDR CIS IS Leg #	None	None	The engineer manually populates this data to ensure its accuracy.
AEDR CIS Load Pole/Pad	None	None	The engineer manually populates this data to ensure its accuracy.

To populate these fields, the user will first select the CISInstalledService feature for the service request. Then after loading the ArcFM Service Request Page Template, the user will use the standard ArcFM "Refresh ArcFM AutoText" right-click option shown in Figure 2.12-4.
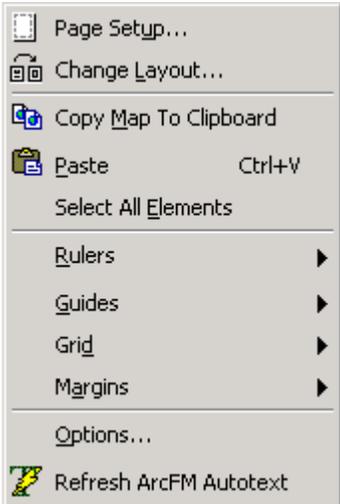
Figure 2.12-4. Refresh dialog box.

The user will then populate any remaining fields, check boxes, etc. using the standard ESRI drawing tools available on the drawing toolbar shown in Figure 2.12-5.

Figure 2.12-5. Refresh dialog box.

Note: Engineers are able to use the drawing tools to update the Service Request but they are not able to edit any GIS features because they will be accessing the system via their existing ArcView access. They are also able to move (pan/zoom) the extent of the map window on the service request and are able to refresh the ArcFM AutoText if required.

2.12.4.3 Fastpath Cover Sheet

The clerks also create a coversheet for all fast path work. While this coversheet is not stored in the GIS, the creation of the coversheet can be greatly automated by using the GIS to create it. A new ArcFM Page Template is created showing a blank coversheet. ArcFM Autotext is added from the previous section where applicable. See Figure 2.12-6.

FAST PATH COVERSHEET

RECORDS

SITE ID: 22A970007   ADDRESS: 4592 E 8TH PL   CITY: Gary

SUBDIVISION: Unknown

NOTES: _____

_____ GAS ONLY   _____ ELECTRIC ONLY   _____ BOTH   _____ TEMPORARY

ASSIGNED TO: _____   DATE: 9/18/2003

ENGINEERING

FIELD INSPECTIONS:

DATE	SITE CONDITIONS

SPECIAL REQUIREMENTS

	Yes	No
10-Day Pledge		
Joint Trench		
Joint Core Work		
Directional Bore		
Road Bore		
Welder		
Buried Hazard Marker (Customer Owned)		
Clearance		
Scheduled Outage		
Meter Shop		
Traffic Control		
Tree Trimming		
Easement Work		

SITE READY

ENGINEER CONFIRMED

ELEC LOAD P: _____   METER SIZE: _____   SERVICE VOLTAGE: _____
GAS LOAD P: _____   METER SIZE: _____   METERED VOLTAGE: _____

DISPATCH

LOCATE INFORMATION

	Yes	No
Locates Required?		
Inside City Limits?		
Locate both sides of road?		
Road Bore Required?		
20' Radius around pole		
Locate entire property		
Locate gas service from road to main		
Locate from pole/pad to electric meter		
Is NIPSCO class path flagged or staked?		

		N	S	E	W
Road:	Size	N	S	E	W
Alley:	Rear	N	S	E	W
Ditch:	Rear	N	S	E	W
Barrow		N	S	E	W

Gas service crossing street _____
Within ½ mile of site?   Y   N

Alt Response	Inside/Out	Other	NON-NIPSCO UTILITIES
			_____

LOCATE NUMBER: _____
DATE & TIME LOCATE READY: _____
DATE LOCATE EXPIRES: _____

SITE CONTACT		RECORDED IN TO WORK LOG?	
NAME:	RHONDA R REV	DATE:	BY:
PHONE #:			

GENERAL COMMENTS:

CREW

READY FOR TERMINATIONS

DATE:	NOTED BY:		HOLE OPEN:	Yes	No

READY FOR BACKFILL

DATE:	NOTED BY:	DATE COMPLETED:	
		COMPLETED BY:	

CSG

RECORDED IN TO WORK COMPLETION REPORT   DATE: BY:

Figure 2.12-6. Fastpath cover sheet.

The clerk will fill out most of the rest of the form via the standard ESRI drawing tools. Unfortunately, ESRI does not have the functionality of a standard check box control for page templates. For this reason a small plug-in has been built to allow the clerks to easily update the check boxes on the page. The clerk will first click the Fast Path Coversheet Checkboxes option on the Service Requests drop down. See Figure 2.12-7.
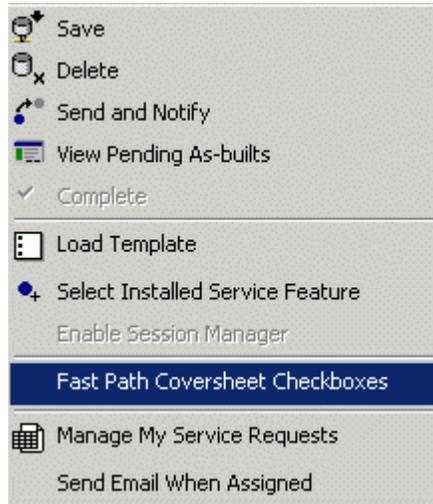
Figure 2.12-7.

The user is then presented with a screen where they can check or uncheck the appropriate checkboxes for the template as shown in Figure 2.12-8.

Fast Path Coversheet Checkboxes

Check the boxes and they will be updated on the coversheet for you

Field Inspections

Special Requirements

	Yes	No
10-Day Pledge	☑	☐
Joint Trench	☑	☐
Directional Bore	☐	☑
Road Bore	☐	☑
Welder	☐	☑
Buried Hazard Marked (Customer Owned)	☐	☑
Clearance	☑	☐
Scheduled Outage Meter Shop	☐	☑
Traffic Control	☐	☑
Tree Trimming	☐	☑
Easement Work	☐	☑

ENGINEER CONFIRMED
☑ Elec
☐ Gas

Locate Information

	Yes	No
Locates Required?	☑	☐
Inside City Limits?	☑	☐
Locate both sides of road?	☐	☑
Road Bore Required?	☐	☑
20' Radius around pole	☑	☐
Locate entire property	☐	☑
Locate gas service from riser to main	☐	☑
Locate from pole/pad to electric meter	☑	☐
Is NIPSCO clear parth flagged or staked?	☐	☑

Road: Both ☐ N ☑ S ☐ E ☐ W ☐
Alley: Rear ☐ N ☐ S ☑ E ☐ W ☐
Esmt: Rear ☐ N ☐ S ☑ E ☐ W ☐
House: N ☐ S ☑ E ☐ W ☐

Closest Intersecting Street:
Withing 1/4 mile of site?   Y ☑   N ☐

No Response	Will Be Out	Clear
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐

Ready for Terminations

	Yes	No
Hole Open:	☐	☑

[Reset] [Update Coversheet]   [Cancel]

Figure 2.12-8. Fastpath coversheet dialog checkbox.

After updating this form and clicking the Update Coversheet button, the system will update the page template with the appropriate checkboxes. This automation saves the clerk significant time. The clerk then prints the coversheet and sends it to the engineer working the service request.

2.12.4.4   Storage of In Process Service Requests

From the time the clerk first creates the service card until it is exported as a PDF, the service request will need to be stored in a manageable and updateable format. This is accomplished by using the existing ArcFM Stored Document infrastructure. A new drop down (see Figure 2.12-9) has been added to the AEDR Toolbar to save and load existing Service Requests.
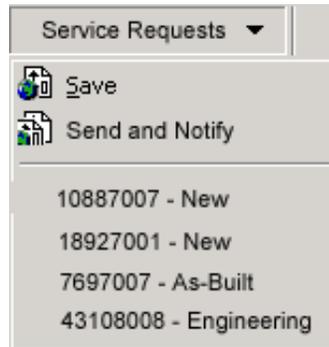
**Figure 2.12-9. Dropdown functions
to save and load service requests.**

This drop down works in a similar fashion to the ArcFM Stored Display, Page Template, and Document Drop downs. Clicking "Save" saves the current service request as an ArcFM Stored Document under the current user's Service Request drop down. It is automatically named with the CIS Site ID and the status of "New". When the clerk is ready to send the service request to an engineer, they click the "Send and Notify" button. Figure 2.12.10 is the prompt that will be shown.
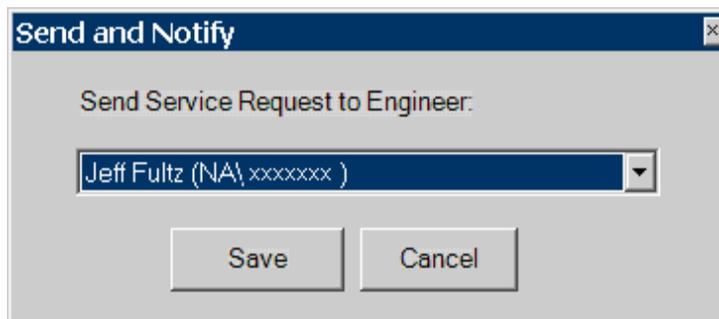
**Figure 2.12-10. Dialog box to facilitate choosing
and sending the request to the engineer.**

The clerk will select the engineer responsible for completing the service design and load information and clicks the "Save" button. The Service Request template (including current data) along with a reference to the spatial location will be saved as a User Stored Document and will be assigned to the specified engineer's Service Request Stored Documents. An automated email is then sent to the engineer informing them that the new Service Request is available for processing.

The engineer is able to access the Service Card Stored Document under the Service Request drop down Figure 2.12-9. A list of all assigned Service Request Stored Documents is displayed with the Site ID and a status of "Engineering". The engineer will click on any of their assigned Service Requests to load the document. Engineers can only see the Service Requests that have been assigned to their user account. If a Service Request needs to be reassigned for any reason (Work Load, Vacation, Sick, Reassigned) the engineering supervisor is authorized to reassign a service request via a simple SAGE tool. The team lead of maps and records has the ability to allow other individuals (engineering, managers, etc) to use the SAGE reassignment tool if needed based on assigned SAGE permissions.

The engineer will then make any needed updates to the service request. Often, the "Released for Construction" milestone will have been completed by this point in CIS. If needed, the engineer can select the CIS Installed Service Point in the GIS and refresh the ArcFM AutoText elements to acquire any new data that has been made available from CIS.

When the engineer has completed their updates to the Service Request and has sent it to the field for construction, they will send it back to a record clerk to complete the as-built updates. The engineer clicks the "Send and Notify" button and will receive the following prompt shown in Figure 2.12-11.
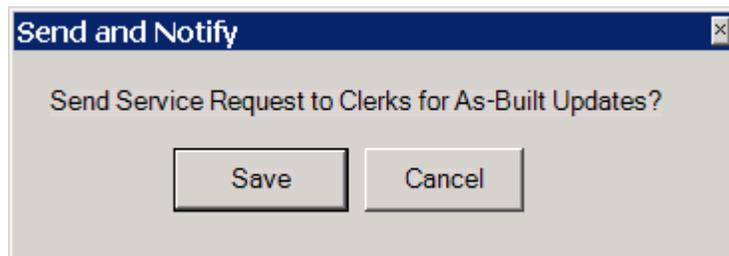
Figure 2.12-11. Dialog box to facilitate choosing and sending the request to the engineer.

The Service Request will then be saved as a User Stored Document and will be assigned to the pending as-built queue. The clerks will not be notified via email because they are not required to complete the service request until the paper copy of the as-built updates is returned from the field. When a clerk receives the paper as-built updates, they will click a button titled "View Service Requests Pending As-Built Updates". This button launches the form shown in Figure 2.12-12.

Figure 2.12-12. Form to view the pending as-builts.

The clerk can view any available service requests that are pending as-built updates by selecting a value for the LOA. Any matching, unassigned service requests will be displayed in the data grid keyed off of the site ID. The clerk will then select a service request and click the "Assign & Load" button. This button will assign the service request to the clerk and will load the ArcFM Stored Document. Going forward, the clerk is able to access the Service Request Stored Document under their Service Request drop down list. All assigned service requests are shown with the Site ID and the status of "As-Built". If a Service Request needs to be reassigned after this point for any reason (Work Load, Vacation, Sick, Reassigned) the team leader of maps and records will be able to reassign a service request via a simple SAGE tool. The team leader of maps and records will also have the ability to allow other individuals (managers, leads, etc) to use the SAGE reassignment tool if needed based on assigned SAGE permissions.

The clerk will then make the as-built updates. If needed, the clerk may also move the CIS Installed Service feature based on the as-built markups.

2.12.4.5   In Process Service Request Management

It was noted that an engineer may have hundreds of service requests assigned to them at any given time and it would therefore be hard to manage the service requests using only the Service Request dropdown which shows the site ID, type, and status. For this reason, an option has been added to the Service Requests drop down – "Manage My Service Requests" as shown in Figure 2.12-13:
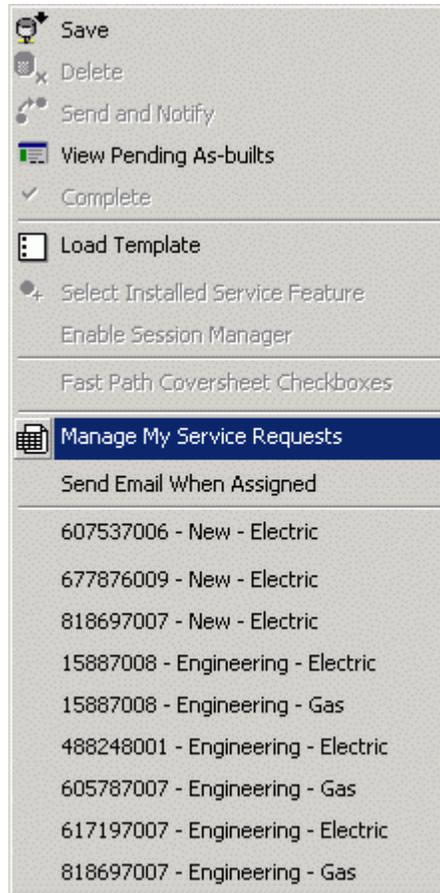
Figure 2.12-13. Manage my service requests prompt box.

Clicking this option brings up the advanced management screen shown in Figure 2.12-14:
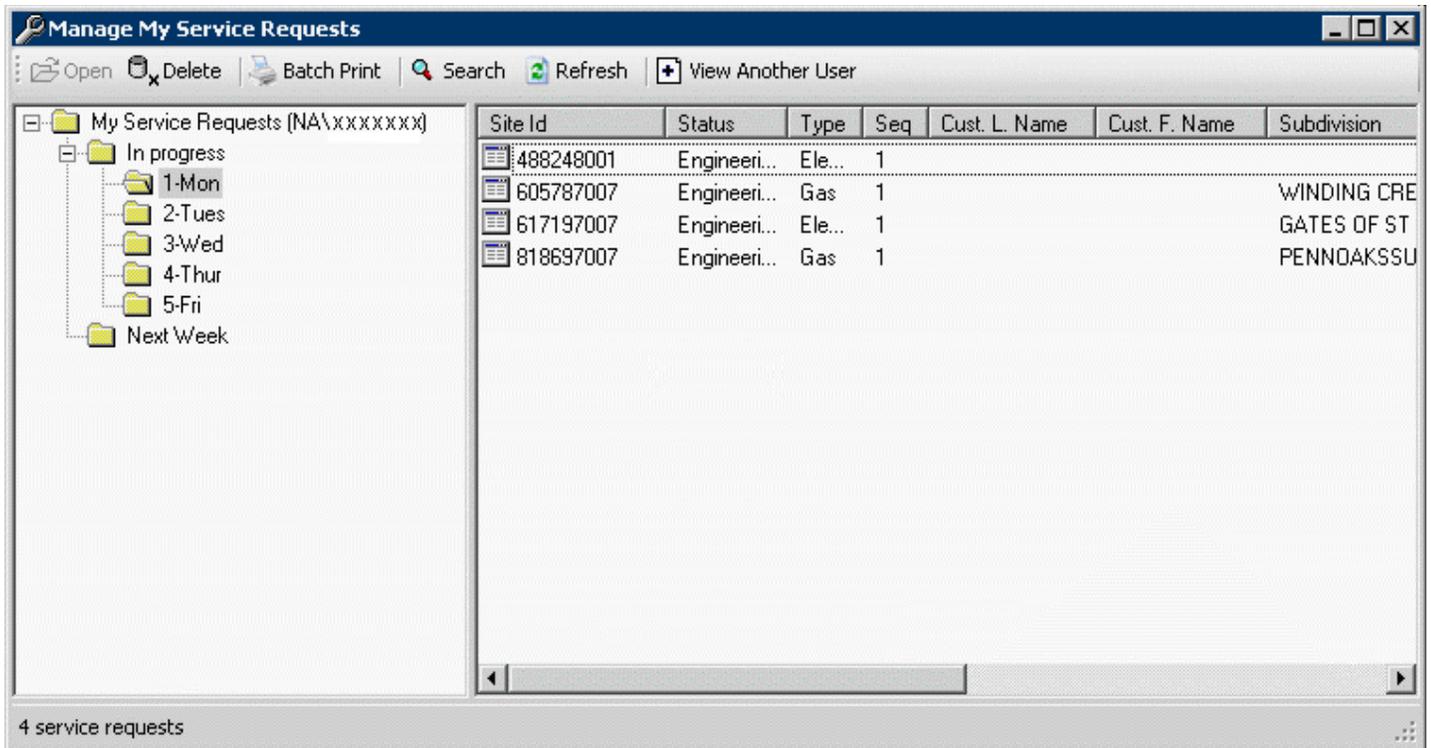
**Figure 2.12-14. Manage my service
requests dialog box.**

This screen allows engineers (and also clerks if needed) to create a folder structure to manage their assigned service requests. The folder structure is unique to each user and is stored in the Geodatabase. The service request entries in the right hand pane show all of the significant fields that identify a service request including site ID, status, type, sequence number, customer name, subdivision, full address, and LOA. This makes it very easy for the user to identify a specific service request. Right-click menus have been developed for the service request entries in addition to the buttons at the top of the screen as shown in Figure 2.12-15 to make it easy for the user to access all functionality related to the service request:
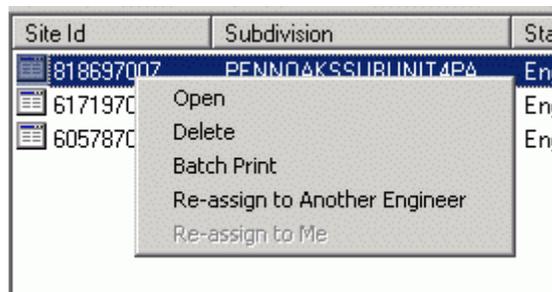
**Figure 2.12-15. Right-click
menus for ease of use.**

The Open option will open the service request for editing within the GIS. The Delete option will delete the service request completely from the system. The Batch Print option can be launched for a single service request, a multi selection of service requests, or even

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an entire folder of service requests (including sub folders). When clicked, the following print dialog is shown in Figure 2.12-16.
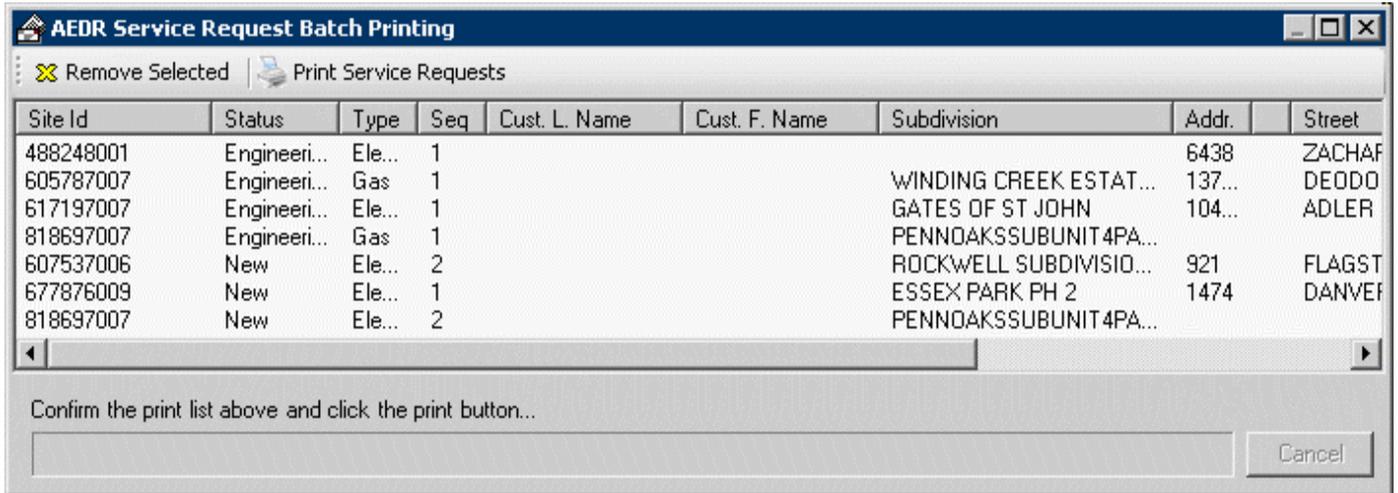
Figure 2.12-16. Service Request print dialog box.

Figure 2.12-16 dialog allows the user to remove service requests if needed and then to print all included service requests to any local printer. This functionality is heavily used by engineers who do not have laptops in the field. They can batch print a set of service requests in the morning and then head into the field to design each service.

The management tools also allow engineers full control over reassigning their own service requests to others and assigning other's service requests to themselves. This option is available from both the right-click function and the button at the top of the screen.

Finally, the management tools provide full searching of the service requests loaded into the tool. This allows users with hundreds of service requests to locate a specific service request very quickly. This has proven helpful when responding to customer phone calls or other real time inquiries. The user clicks the Search button at the top of the screen and the search panel is added to the bottom of the management window in Figure 2.12-17.
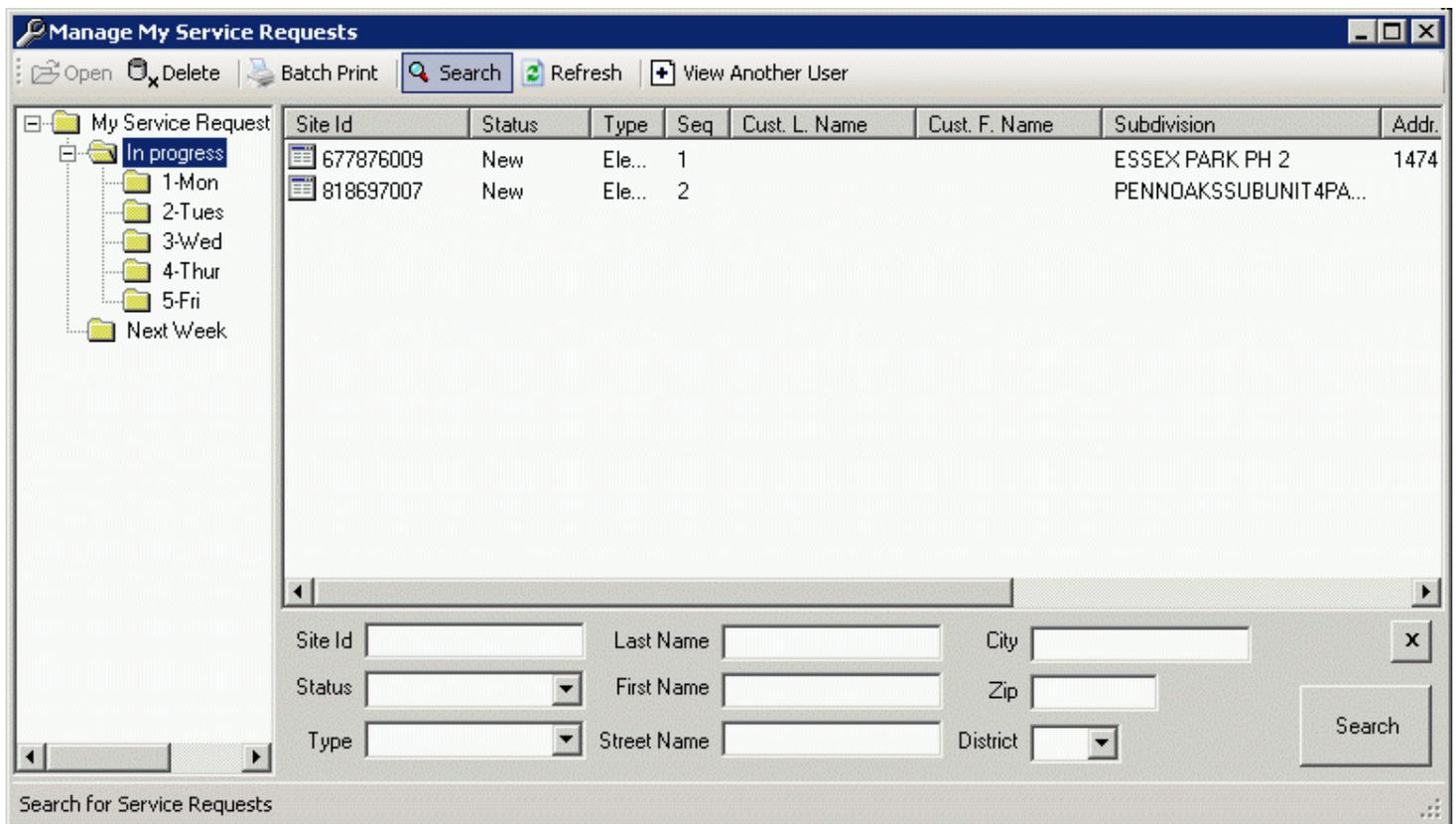
Figure 2.12-17. Service Request print dialog box.

The user can input any combination of search fields and then click the Search button. Any matching service requests will be shown in the main panel and the user can open, delete or reassign the service request as needed.

2.12.4.6   Completion, Exporting and Linking

Once the final as-built updates have been applied to the Service Request Stored Document, the clerk will once again select the CisInstalledService feature in the GIS and will then click a new button titled "Complete the Service Request". The system first prompts the user to confirm the choice to complete the service request. Upon confirmation, the system exports the current Service Request Stored Document to a PDF file which is saved to a configurable file server network location. The Service Request Stored Document is then deleted from the ArcFM/ArcGIS system to conserve storage space in the geodatabase.

Next, the system will update the selected CISInstalledService feature by populating the ServiceRequestLink field with the file reference of the newly created PDF file. This allows a hyperlink field to be defined on the CIS Installed Service layer in the standard AEDR Stored Displays. The CIS Installed Service Points can then be clicked using ESRI hyperlink tool to view the PDF files. This functionality is available to any user who accesses the standard AEDR Stored Displays that contain the CIS Installed Service features.

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Only clerks will be able to perform this completion step because it will require the ability to edit the GIS Installed Service features via ArcEditor.

2.12.5   GIS/CIS Batch Updates

When *updates* to CIS Site and Installed Service records are passed from CIS to GIS a process was developed to push the updated data from the interface tables into any existing GIS CISSite objects or CISInstalledService features respectively. The existing CIS batch processes were updated to allow updated (non-pending) records received from the CIS, to attempt to match them against existing GIS objects/features. If a match is found, the updated data from CIS will be applied to the GIS record.

This update will ensure that if the ArcFM AutoText is refreshed after the initial creation of the Service Request, any updated CIS data (including Customer Name) will be populated if it has since become available from CIS.

2.12.6   Linking Existing Service Requests

All legacy service request forms have been scanned and are contained in TIF files. These TIF files are currently stored on an existing AEDR production server. With the addition of the ServiceRequestLink field to the CisInstalledService feature class within AEDR, it is desirable to provide links to all the legacy TIF service request scans in addition to all new PDF service requests.

The TIF files are indexed with a unique ID that was assigned by the process that is in place today. This unique ID is then tied to a CIS Site ID within a SQL Server database that is hosted on the AEDR production server. The database is named NIPSCO Gas Service Card and the linking table, named dbo.Links, is defined as SiteId int and ImageID bigInt.

The existing AEDR Gas Service Card Viewer web application is responsible for serving these legacy TIF service requests based on Site ID. An example HTTP request is shown in Figures 2.12-18 and 2.12-19.
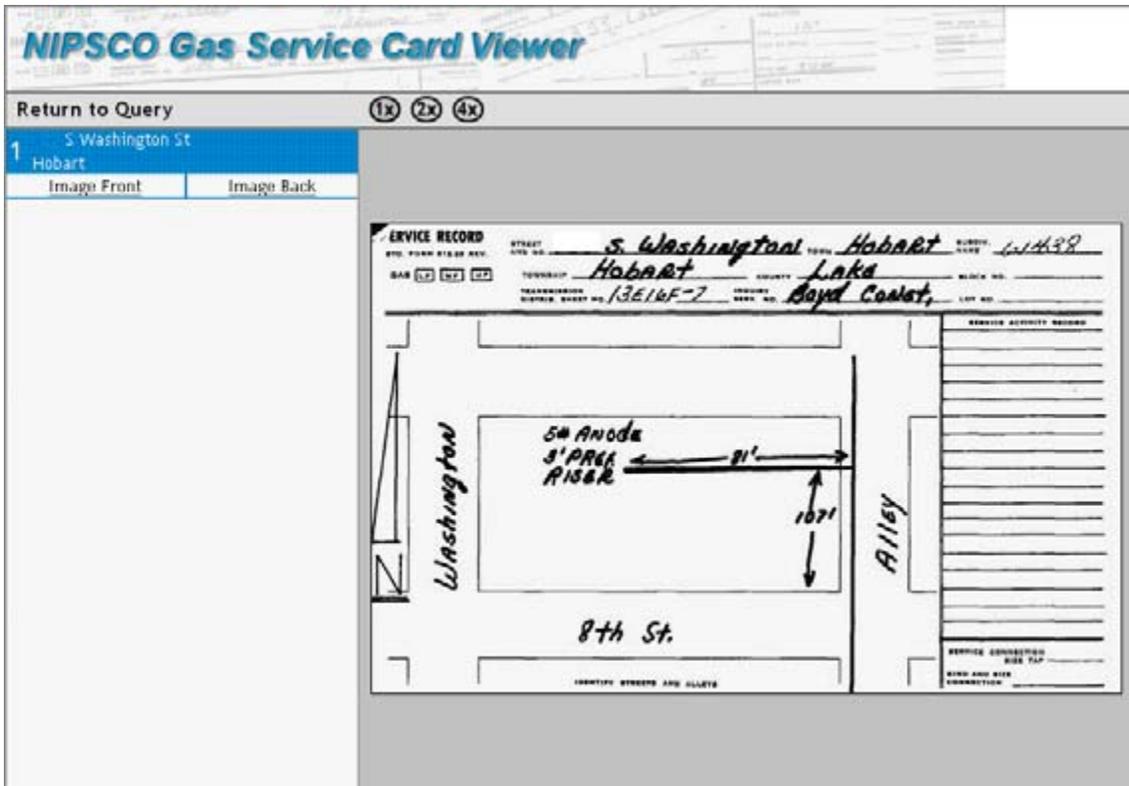
Figure 2.12-18. Service card viewer-front image.
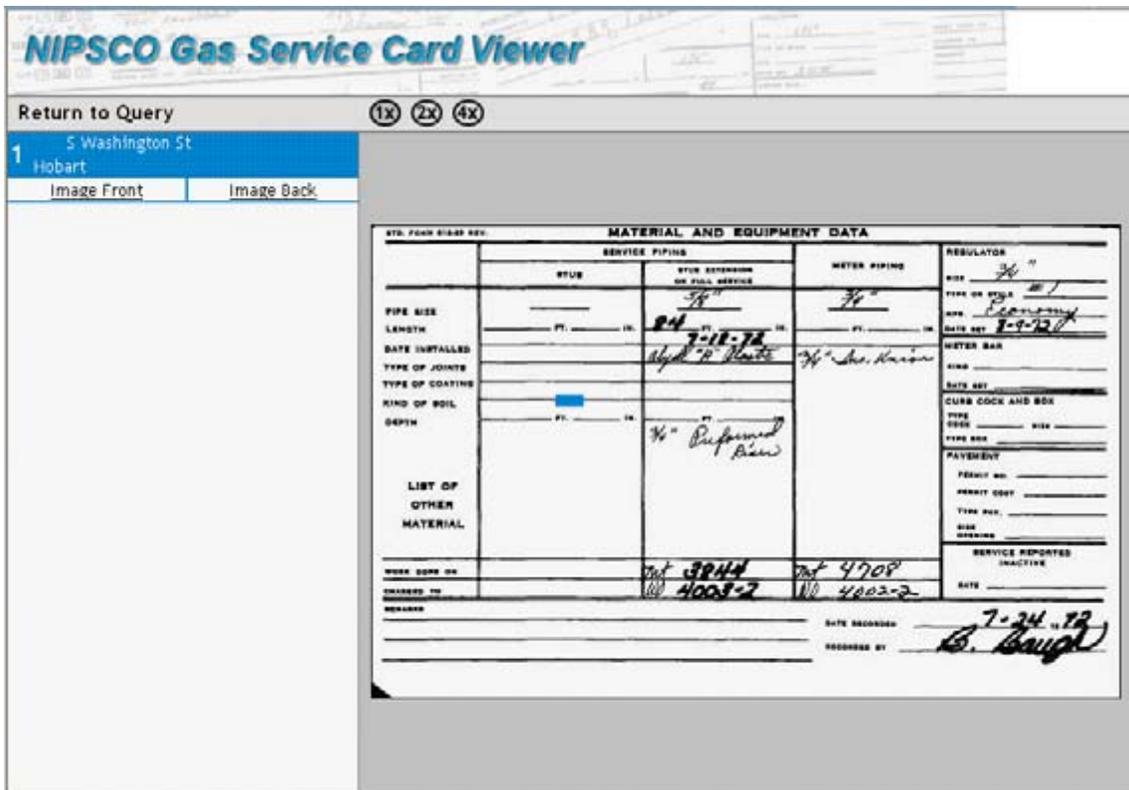
Figure 2.12-19. Service card viewer-back image.

The Gas Service Card Viewer application then uses the above mentioned table to match the site ID with any available TIF image IDs and subsequently displays the available service request images in a web browser. This existing infrastructure is re-used to link the legacy service requests to the CisInstalledService GIS features. A small data loader application was written that processes all available site IDs contained in the dbo.Links table. It first checks to see if there are any CisInstalledService features in the GIS that have a matching site ID. If matching site IDs are found, it generates a link in the following format and inserts it into the CisInstalledService.ServiceRequestLink field shown in Figure 2.12-20.
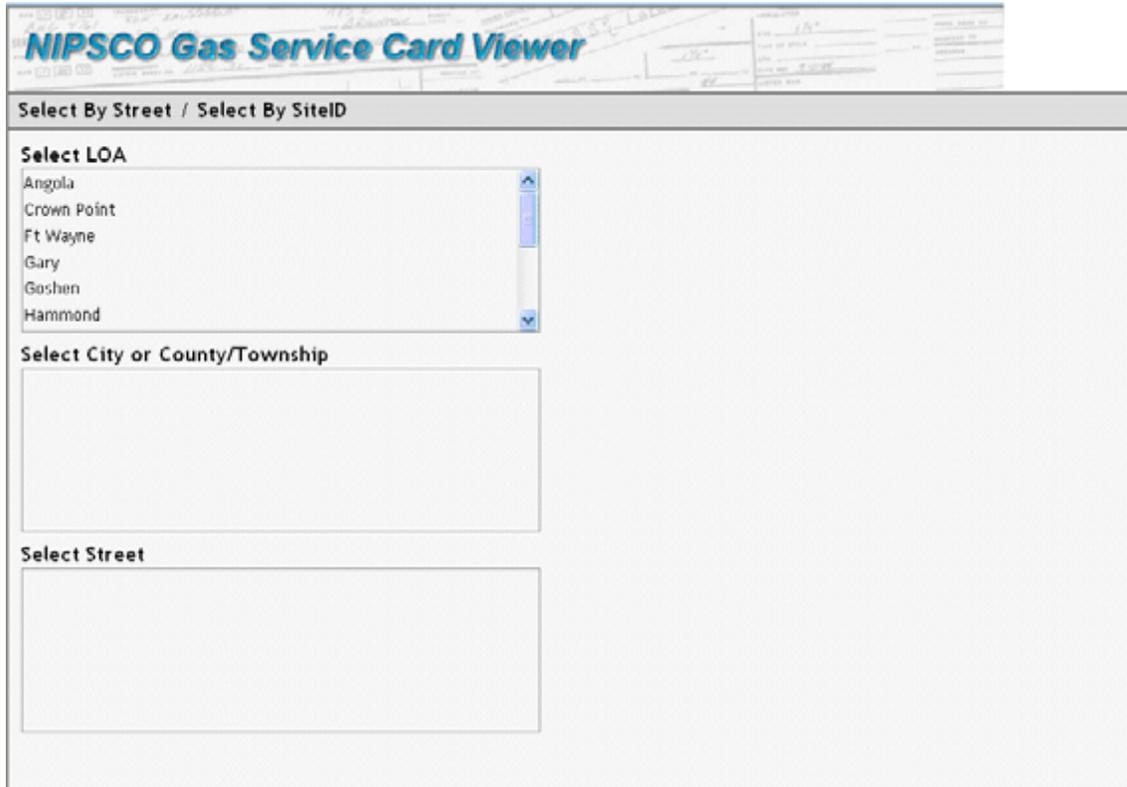
Figure 2.12-20. Service card viewer query dialog box.

The Site ID is auto-populated. This approach works well because it allows the AEDR GIS to maintain a single link to any matching service request even though the legacy TIF service requests typically maintain two individual scans representing the front and back of the service card. The Gas Service Card Viewer handles displaying the multiple images for a single site ID.

2.12.7　　　New PDF Service Request in the Gas Service Card Viewer

The legacy Gas Service Card Viewer which is used directly by the AEDR Facility Browser to display service request images was originally limited to the TIF image format. This application was modified such that the new PDF service requests are also available via the legacy Gas Service Card Viewer. The file storage location for the new PDF service requests are hosted alongside the TIF images on the production server.

Once PDF files were made available by the Gas Service Card Viewer, additional coding was performed to automate the inclusion of new PDF Service Cards to the Gas Service Card Viewer system from the GIS. The NIPSCO Gas Service Card database was updated with a reference to the new PDF via Site ID and also references the PDF by LOA, City, and Street so that the existing Gas Service Card Viewer navigation tools can continue to be used to view all available service cards for a chosen street. A step was added to the PDF export process to also write the required location information directly to the NIPSCO Gas Service Card database. This provided the most seamless integration as the new cards are immediately available in the Gas Service Card Viewer upon completion in AEDR.

2.12.8　　　Workflow for Service Stubs

Clerks were required to make up service cards that show the stubs even though there was no pending order from CIS. The service cards were the only place that the stubs were recorded. They were kept in a file in each LOA for reference when there was work in a specific area. In a large subdivision there may be many stubs and the creation of individual service cards for each was a time consuming process that resulted in data that is not very accessible. When an actual service was later installed, the clerks typically made copies of the stub service card and then updated it with the actual service design and information.

The AEDR GIS data model provides a way to enter the stubs as actual GIS features instead of creating service card "stubs". Electric stubs are created as UG Secondary features and gas stubs are created as Gas Service Stubs. Both of these features allow the user to enter the key information that needs to be tracked for the stub in GIS as well as property records.

When the pending installed service is later submitted from CIS, the service line can be drawn tapping directly off of the stub feature. This helps to clarify that the new installed length of service is only from the stub and not from the main line (gas main/conductor). An additional stub-driven service request page template was created to allow even more auto-population of the service request based on the attribution of the stub. A service card is only created when the actual service is installed which effectively reduces the number of service cards that must be maintained in the system.

2.12.9 Service Request Implementation

The Automated Service Request was implemented into production in May 2007. The Implementation tasks were governed by the Deployment Phase II Plan located in Appendix A.

All production installations require 100% passing execution of written test cases. The Automated Service Request Test Plan is located in Appendix B.

The Service Request implementation was preceded by training the users; record clerks and engineers via multiple instructor-led web conferencing sessions. Additionally, Service Request user instruction was added to the AEDR Online Help system to augment the training. See Figure 2.12-21.
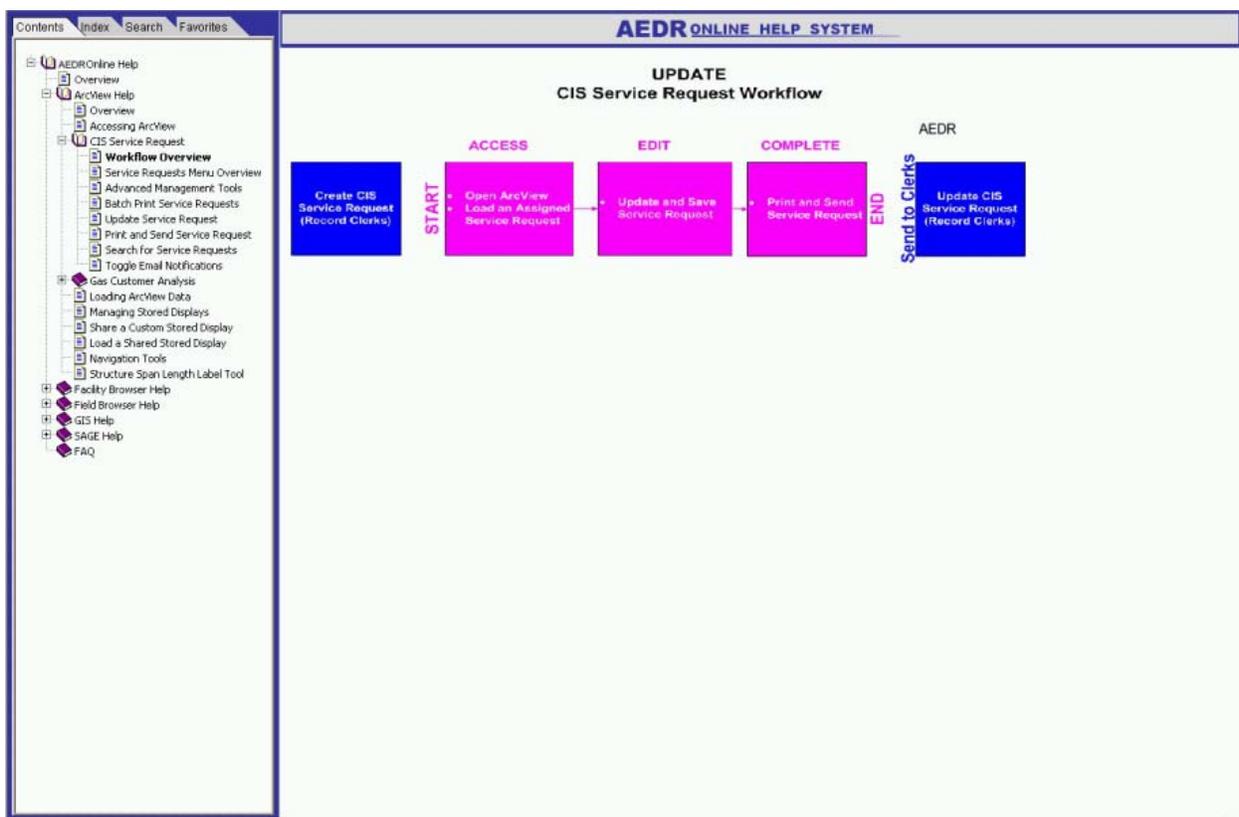
Figure 2.12-21. Service card viewer query dialog box.

The Service Request rollout into production began with a pilot on September 17, 2007. The pilot included one LOA run for one full week to ensure feasibility and address any problems before implementation for the remainder of the company. In the results of the pilot, we determined the most successful production implementation would be single LOA rollouts with assistance at each site until the Automated Service Request process for all LOAs were completely in production. Seventy-five percent of the LOAs are now using the Automated Service Request process with the remainder expected to be in-service in May, 2008.

2.13 Gas Customer Analysis

2.13.1   Overview

The NIPSCO Gas Operations group is responsible for dispatching gas repair crews and managing all aspects of gas outages within the NIPSCO territory. They are also responsible for managing any planned repairs that are required for various system maintenance activities. The Gas Operations group used a manual process to determine which customers might be impacted by a gas outage. Once the location of the gas outage was identified, they queried NIPSCO's Customer Information System (CIS) to determine which customers are close to the outage location. They then manually created targeted customer lists as well as field outage forms to be used by the NIPSCO gas field crews while restoring the gas services. This manual effort was highly time consuming which resulted in poor time utilization of the Gas Operations personnel. This document outlines the customization developed to automate much of this manual work enabling the user to concentrate on more important activities including field dispatch, coordination, and customer support.

The objectives of this customization was to create functionality in the AEDR ArcGIS/ArcFM system to satisfy all business needs related to the gas customer analysis involved with managing gas outages:

- Allow users to select gas mains on a map involved in an outage.
- Provide statistics on the types of gas mains involved in the outage (transmission, high, medium, and low pressure).
- Allow users to create a visual buffer around the gas mains involved in the buffer to view overlap with customer points on the map.
- Extract all customer data from within a buffer on the map. Display this data in a tabular format.
- Allow users to interactively remove customers from the list.
- Allow users to interactively add customers from the map to the list.
- Search the AEDR CIS interface tables for any customers that may exist at or near the gas outage that may not be on the map.
- Export the master list of all customers into an MS Excel spreadsheet.
- Generate formatted NIPSCO gas outage field forms and export to MS Excel spreadsheets.
- Allow the user to easily print the gas outage forms including page formatting (header, footer, margins, page count, etc).

2.13.2 Workflow

In Figure 2.13-1, the yellow box denotes out-of-the-box functionality and the blue boxes show new custom functionality.
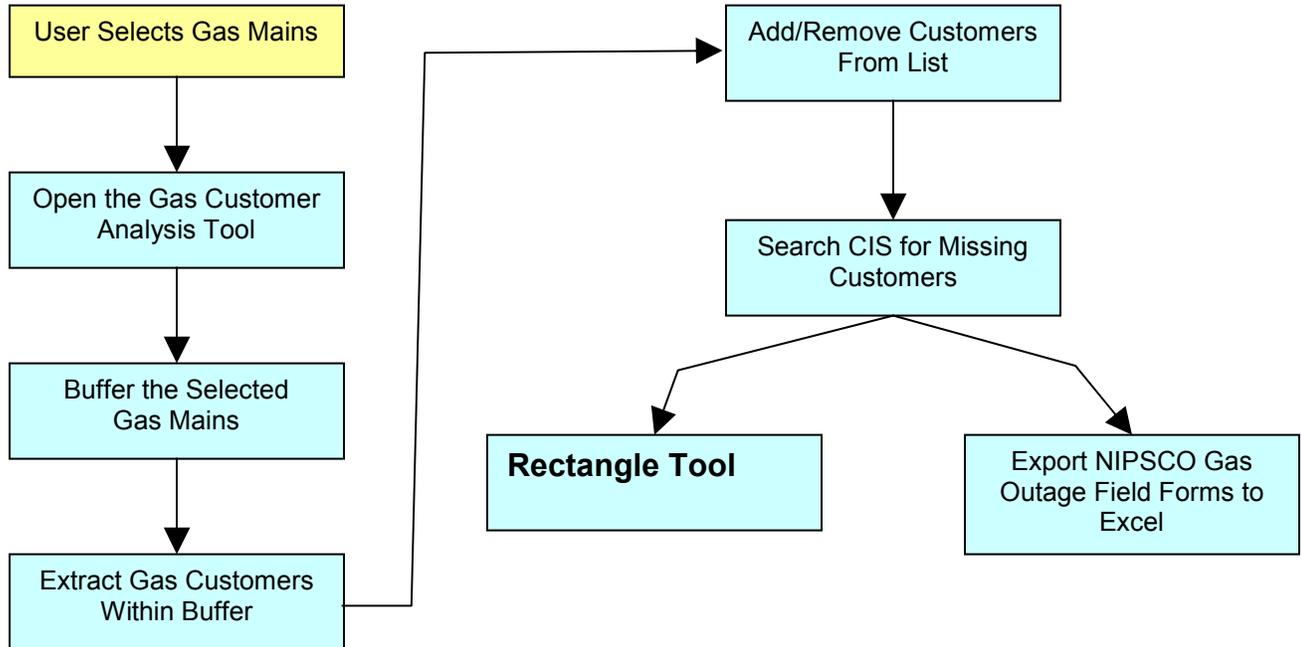
Figure 2.13-1. Gas Customer Analysis Workflow.

2.13.3 Custom Functionality

This functionality was provided with updates to the existing AEDR GIS Client software package. No data model updates were required to support this new functionality. The work flow starts with the user using the out-of-the-box functionality to select one or more gas mains believed to be involved in a gas outage. This is performed using the standard select tool, the ArcFM Attribute Locator, the ESRI "Select By" Attributes or Location, etc. A new ArcFM stored display will be created that provides an ideal view for managing gas outages. The rest of the work flow then uses custom functionality which is described in the following sections.

2.13.3.1 Overview

Figure 2.13-2 shows the new button (circled in red) that was added to the AEDR Tracing toolbar.

Figure 2.13-2.

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The user will click this button to launch a window that shows the details of the currently selected gas mains. The form appears in Figure 2.13-3:
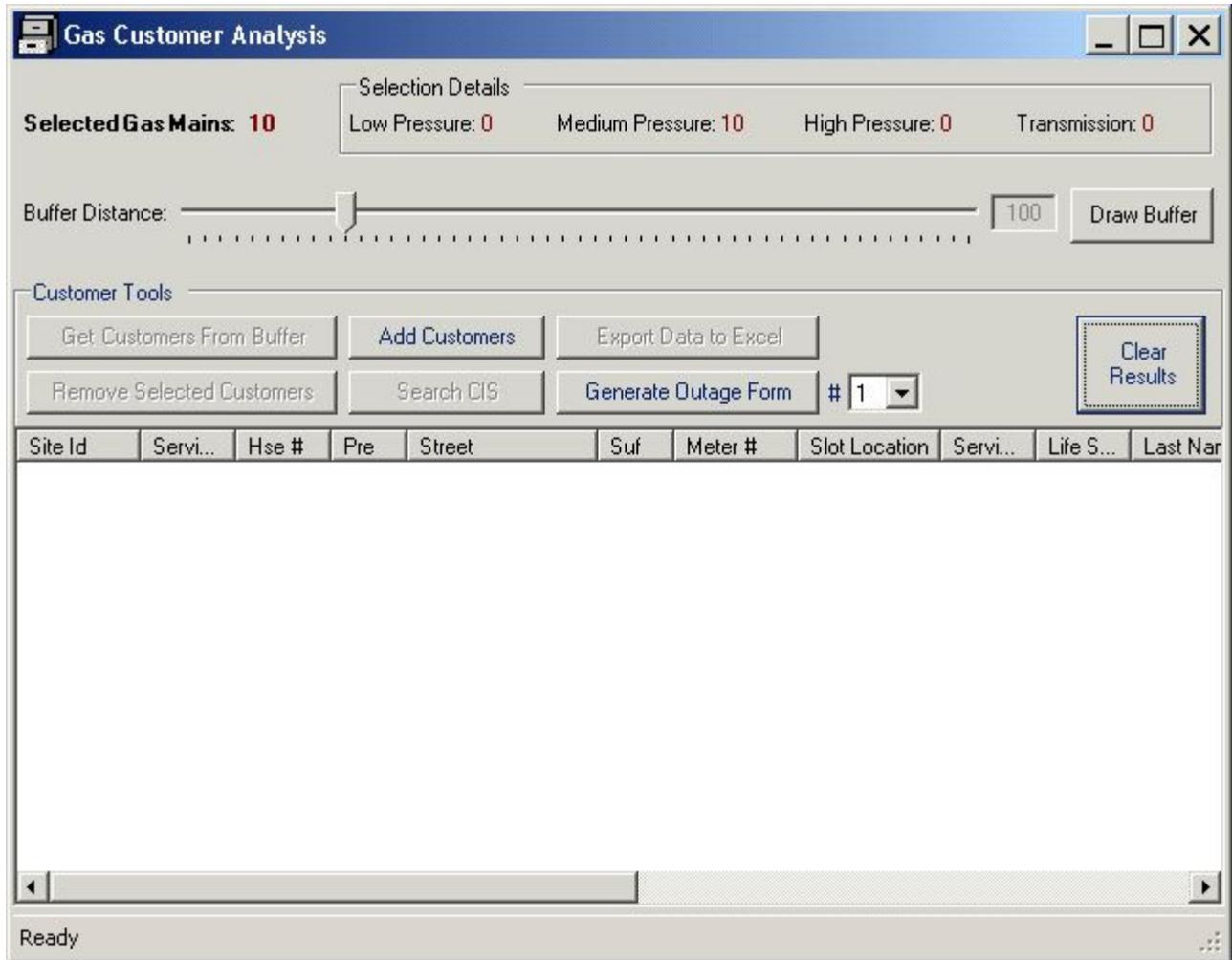
Figure 2.13-3.

The top of the form will always display the number of selected gas mains and will break the selection count down by low, medium, and high distribution pressure, or transmission pipe. As the user interactively changes the selected gas mains on the map, this section of the tool is updated to match the current selection set.

2.13.4   Buffered Selected Gas Mains

Once the user has established the desired selection set of gas mains on the map and has reviewed the selection details in the Gas Customer Analysis window, they are ready to move onto the next step of buffering the gas mains. Near the top of the form the user can move the buffer distance slider to establish the buffer size as shown in Figure 2.13-4.

Figure 2.13-4.

As the user moves the slider, the corresponding value is shown in the text box to the right in Figure 2.13-4. The buffer distance is measured in feet and will be used to create an area around the selected gas main(s) on the map (see Figure 2.13-5). This buffered area will then be used to search for gas customers. The user will click the Draw Buffer button shown on Figure 2.13-4 to see the buffer drawn on the map (Figure 2.13-5).
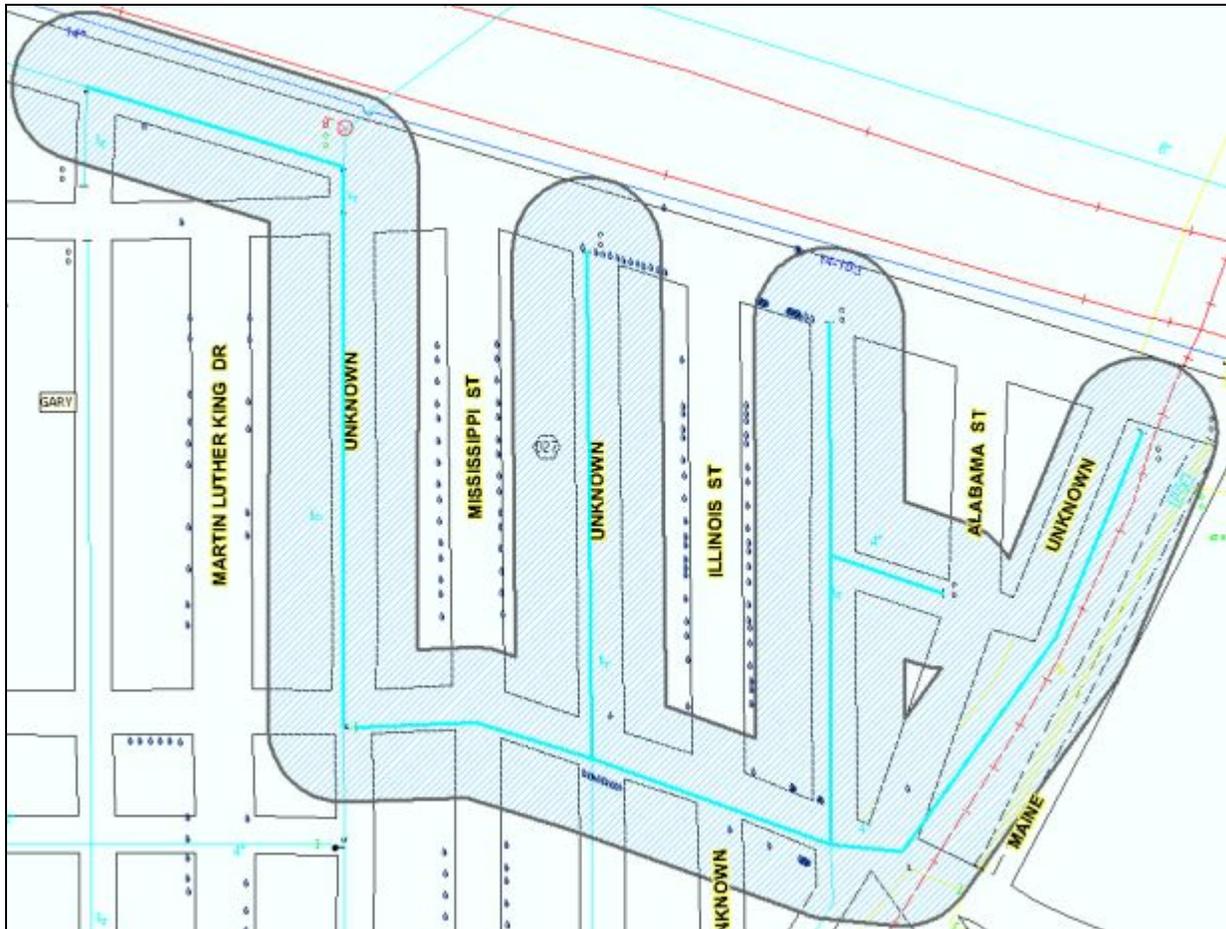
Figure 2.13-5.

The gas customers are represented by the blue dots in Figure 2.13-5 above. The goal of creating the buffers is to set the buffer distance so that the majority of the surrounding customers are included in the buffer on the map. The user can interactively update the buffer distance and redraw the buffer on the map until the buffer includes the majority of the gas customer points surrounding the selected gas main. In Figure 2.13-5, the user would increase the buffer distance and redraw the buffer to try to include more of the surrounding customers.

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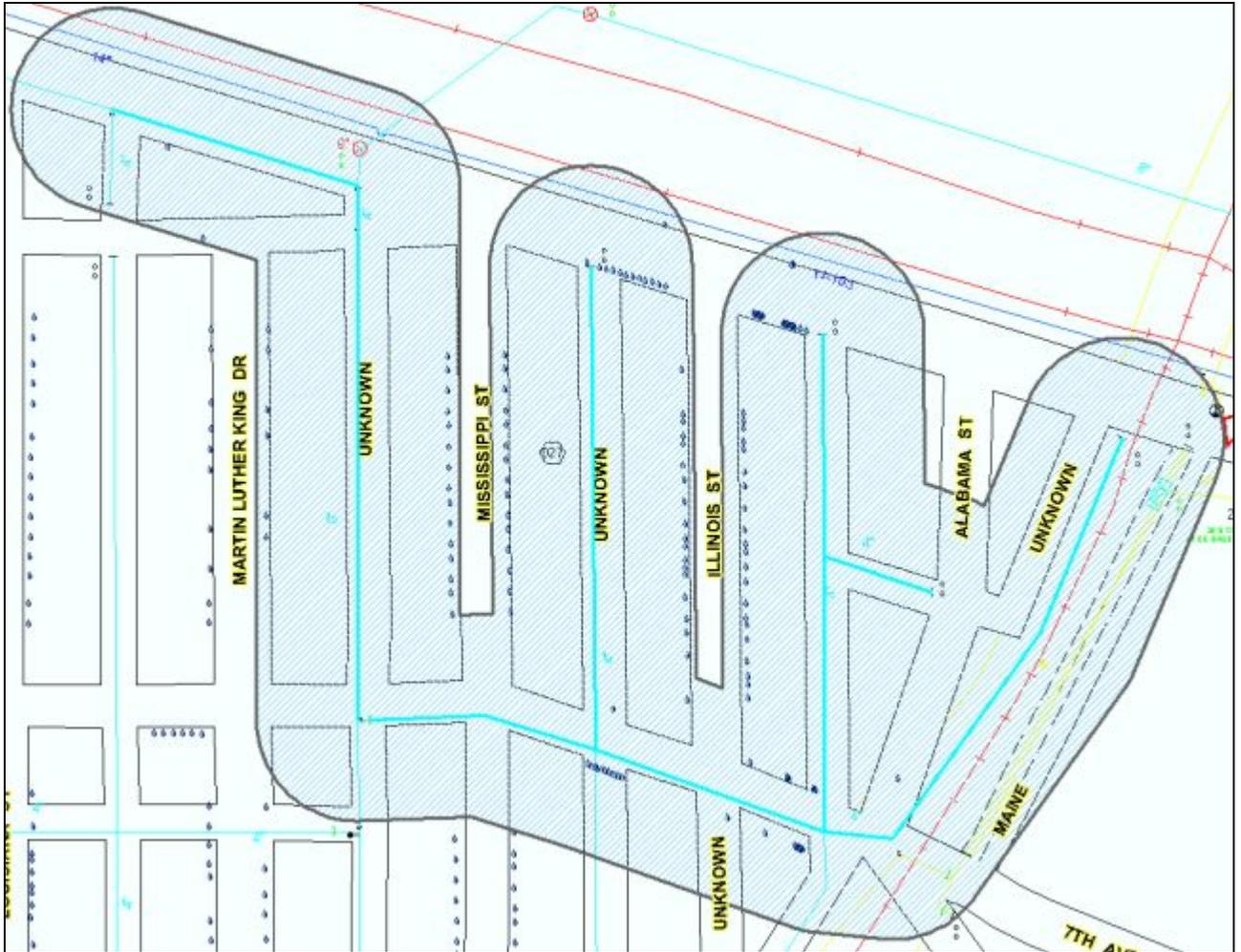
Figure 2.13-6.

In this updated picture (Figure 2.13-6) the majority of the surrounding gas customers are
included within the buffer. The buffer does not have to be perfect but should be created to
maximize the overlap with the largest number of customers. A later section details out
tools that can be used to remove unwanted customers and to add additional customers.

2.13.5 Extract Gas Customers Within Buffer

Once a buffer has been established, the Gas Customer Analysis tool extracts the customer
data from the system for any customer points that are within the buffer with a push of a
button called "Get Customers From Buffer" shown in Figure 2.13-7:

Figure 2.13-7.

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When the user clicks this button, the tool will retrieve all customers that exist within the buffer on the map and will then extract both installed service and site data from the customer records. The customer data will then be listed in the lower section of the tool window shown in Figure 2.13-8.
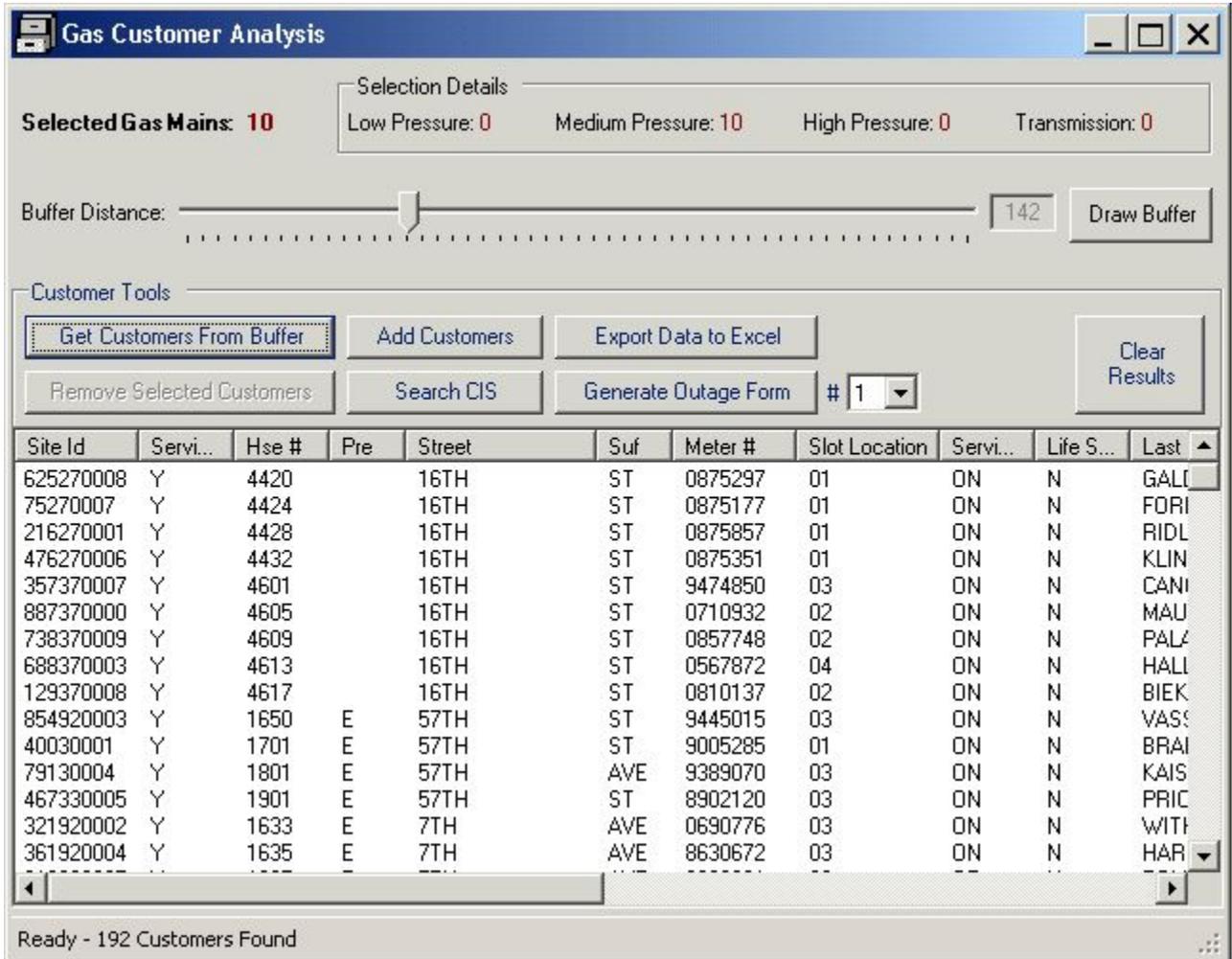
Figure 2.13-8.

The default sort order of the customer data is by street name and then house (HSE) number. The user can re-sort the data at any time by clicking one of the column headings. The first click will sort the data in ascending order and the second click will sort the data in the descending order based on the column clicked. The columns can also be reordered on the form by clicking and dragging any column heading to the desired location. In addition to listing the customer data within the form, the corresponding customers will be colored red/orange on the map to provide a visual indicator as to which customers have been included in the analysis (all other excluded customers will remain blue). The results are shown in Figure 2.13-9.

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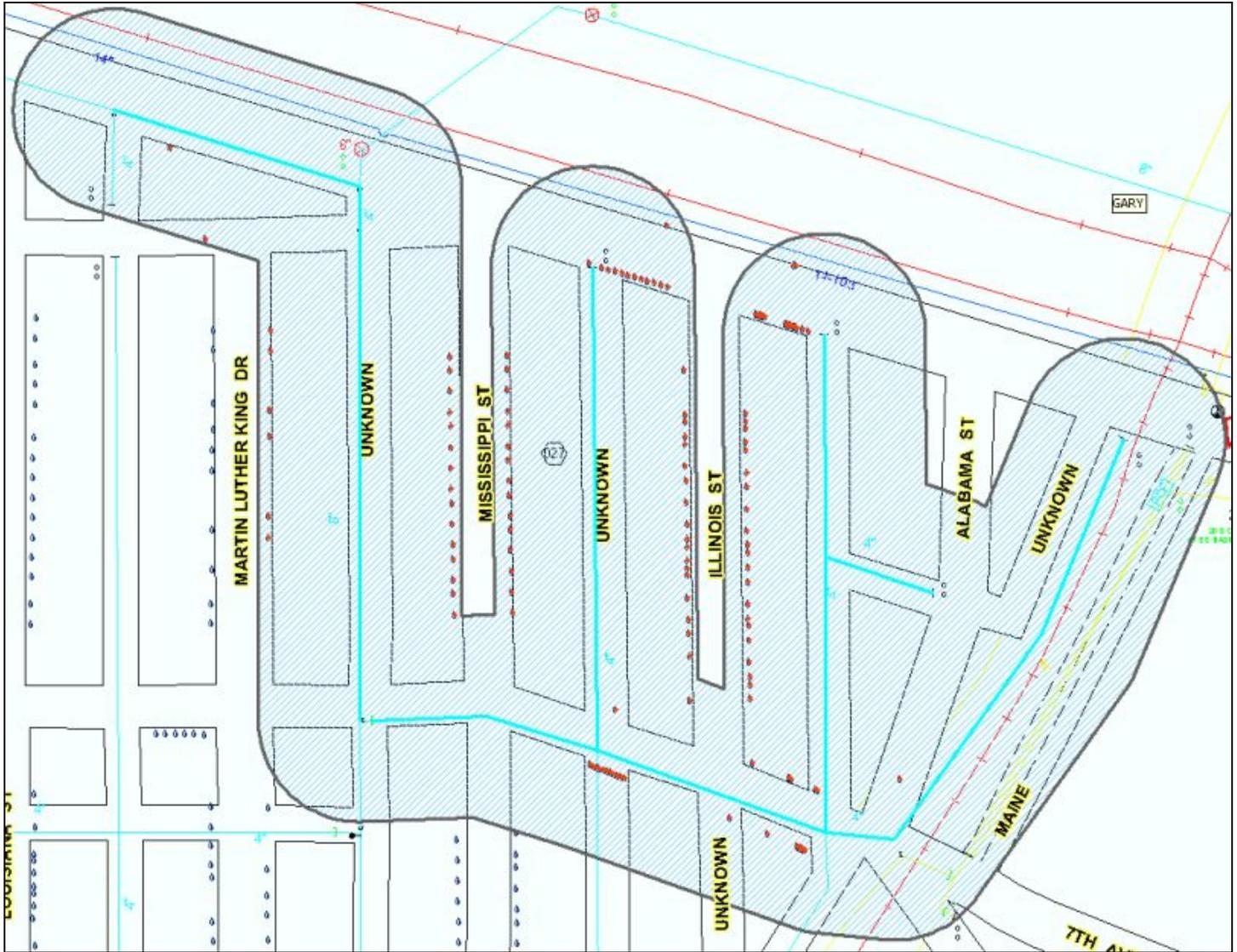
Figure 2.13-9.

As each customer record within the analysis tool is clicked, the corresponding location on the map will flash red. This is very useful when establishing where the specific customers are located.

2.13.6   Add and Remove Customers From List

Often the buffer that was used to get the initial list of customers may include some customers that the user does not want to include in the outage analysis. This may occur because the user had to increase the buffer to a larger size to include the majority of the desired customers but the buffer then also picked up customers from adjacent streets. These unwanted customers can be easily identified by address and/or clicking the records in the analysis tool and identifying them spatially on the map. Once located, the customers can be removed by selecting their records in the analysis tool and then clicking the "Remove Selected Customers" button as shown in Figure 2.13-10.

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Figure 2.13-10.

The selected customers will then be removed from the analysis tool and will also no longer be colored red/orange on the map (they will default to the color blue).

The user may also need to include additional customers that fell outside of the initial buffer on the map. This could occur should certain customers fall just outside of the buffer radius and/or when the user wants to include the additional customers in the outage analysis just to be safe (take the approach of adding proximity customers to ensure the analysis doesn't miss any customers that may actually be included in the outage in the field). As shown in Figure 2.13-10, to add customers, the user can click the "Add Customers" button. When the user moves their mouse over the map, it will show as a cross hair symbol. The user can click and drag a box around the customers that need to be added as shown in Figure 2.13-11.

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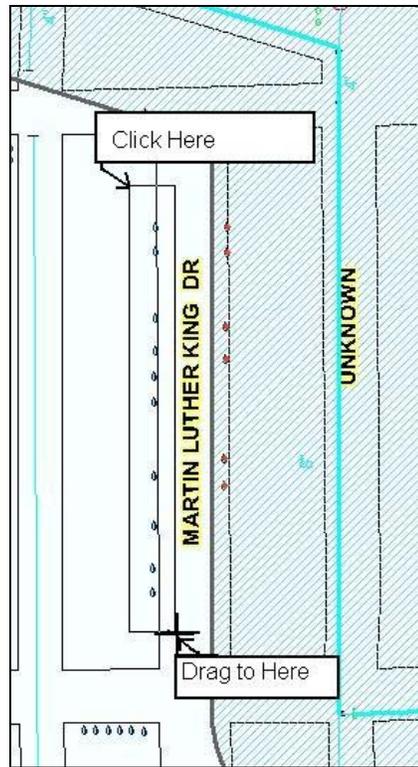
Figure 2.13-11.

Then, as Figure 2.13-12 shows, when the user releases the click and drag operation, the system will locate any gas customers within the box that was drawn on the screen and will add them to the list within the analysis tool AND will color them red/orange on the map to visually indicate that they are now included in the outage analysis (even though they may fall outside of the buffer).
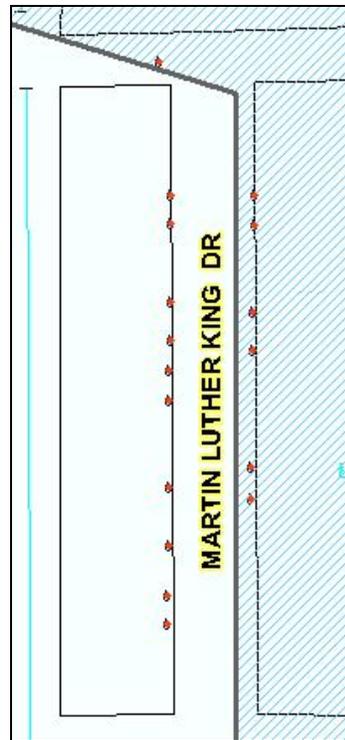
Figure 2.13-12.

By using the "add" and "remove" customer tools, the user can fine tune the customers included in their outage analysis with just a few clicks.

2.13.7   Search CIS for Missing Customers

Because the process for adding new customers to the GIS, and due to somewhat inaccurate legacy data, it was necessary for the analysis tool to provide a search directly against the CIS tables. This direct search ensures that even customers that are not drawn on the map are included in the analysis. Before searching the CIS for missing customers, the user must have an established list of customers on the map based on a buffer, manually adding customers, or a combination of both. This functionality establishes address ranges based on the current customer list and will search the CIS based on those address ranges to determine if any customers are missing from the current analysis. To initiate the search, the user clicks the "Search CIS" button in the tools section of the analysis tool shown in Figure 2.13-13:

Figure 2.13-13.

The application will then process the customers that are currently included in the analysis to establish address ranges. The tool will determine if only odd vs. even addresses are present on each side of each street and will present the user with a comprehensive list of

the address ranges to be searched against CIS. The search details are shown in Figure 2.13-14:

Figure 2.13-14.

If required, the user can update the odd/even/both selection for each individual street. If the address ranges do not appear to be correct, the user can cancel the search and return to the analysis tool. By adding or removing customers from the tool, the user can change the address ranges that are established by the tool. When the correct address ranges have been established, the user clicks the "Search" button on the above search details screen in Figure 2.13-14. The analysis tool will search each street individually against the CIS interface tables and Figure 2.13-15 will display a list of all added customers from the CIS:
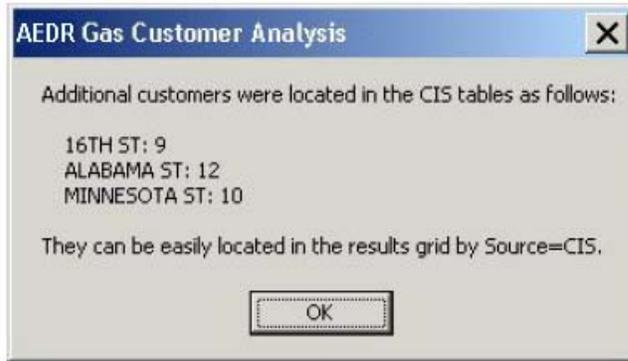
Figure 2.13-15.

After clicking OK, the new customers will be visible in the analysis tool. They can be easily located on the form based on the "Source" column which can be found at the far right of the customer display section. Customers retrieved from the map (either from the buffer or by manually adding customers from the map) will have a Source=Map while customers retrieved from the CIS search will have a Source=CIS. The user can click the Source column header as shown in Figure 2.13-16 to sort the customers by their origination:

Figure 2.13-16.

If required, CIS customers can be removed from the analysis tool in the same way as map customers: by selecting the records and the clicking the "Remove Selected Customers" button shown back in Figure 2.13-13.

2.13.8   Export Customer List to MS Excel

Once the user has established a complete list of customers believed to be representative of the gas outage, they can then export the entire list to an MS Excel spreadsheet which can be printed, saved to disk, or emailed. The user will click the "Export Data to Excel" button in the tools section of the form in Figure 2.13-17:

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Figure 2.13-17.

The tool will then prompt the user for a location and file name for the Excel file. There were intricacies to this process (when running on a Citrix server) that were worked out during implementation. The user can save the file to their local hard drive. The application will then export, format, and save the data into an Excel spreadsheet. The user can then browse to the specified location on their hard drive and can open the spreadsheet in Excel to review, print, email, or further manipulate the data.

Figure 2.13-18 shows the spreadsheet format.

Figure 2.13-18.

The default sort order is street name and then house number (HSE #). Using the Excel sort functions, the user can re-sort the data if needed.

2.13.9   Export NIPSCO Gas Outage Forms

Once the user has established a complete list of customers believed to be representative of the gas outage, the system can then generate the standard NIPSCO gas outage forms to be printed and used during the outage in the field. First the user will need to determine the number of servicemen who will be working the outage in the field. They will enter this value into the drop down to the right of the "Generate Outage Form" button and then click the button in Figure 2.13-19.

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Figure 2.13-19.

The tool will then prompt the user for a location and file name for the Excel files. The user will be able to save the files to their local hard drive. Next, the tool will attempt to order the customers logically based on their location on the map. It will have each serviceman process the odd addresses down one side of a street and then the even addresses up the other side of the street. Once the customer locations are ordered, the list will be divided by the number of servicemen specified in the drop down. The analysis tool will then export individual Excel spreadsheets for each of the servicemen using the name and location specified by the user. A "-#" will be appended to each file name to indicate the individual files for each serviceman. The routing may not be perfect as the application will need to make certain assumptions when determining the order. However, it will at least provide a good starting point.

The user can then browse to the specified location on their hard drive and they will see multiple files equal to the number of servicemen they specified in the drop down as shown in Figure 2.13-20:

OutageForm-1.xls	31 KB	Microsoft Office Exc...	10/15/2007 5:23 PM
OutageForm-2.xls	31 KB	Microsoft Office Exc...	10/15/2007 5:23 PM
OutageForm-3.xls	30 KB	Microsoft Office Exc...	10/15/2007 5:23 PM
OutageForm-4.xls	29 KB	Microsoft Office Exc...	10/15/2007 5:23 PM

Figure 2.13-20.

The user can open each spreadsheet in Excel to review, print, email, and send to the field.

Figure 2.13-21 shows the spreadsheet format:

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Figure 2.13-21.

To make the forms easier to print, an Excel formatting is available to the users to handle the page layout, headers, footers, margins, etc. They users can configure a hot key on their machine to execute the macro and then can simply send the form to a macro. This makes the process of printing many forms very fast. The macro was deployed to each user's machine and has been made available to the users with instructions via the AEDR help website.

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2.13.10 Implementation

The Gas Customer Analysis tool was placed into Production in October 2007.

The Implementation tasks were governed by the Deployment Phase II Plan located in Appendix A.

All production installations require 100% passing execution of written test cases. The Gas Customer Analysis Test Plan is located in Appendix C.

During production rollout, users were trained via multiple classroom style training sessions with hands-on participation. The entire Integration Center was trained in several manageable settings. Upon completion of training, users were immediately able to use the production application for outage situations. Additionally, Gas Customer Analysis navigation and user instruction was added to the AEDR Online Help system to augment the training. See Figure 2.13-22.
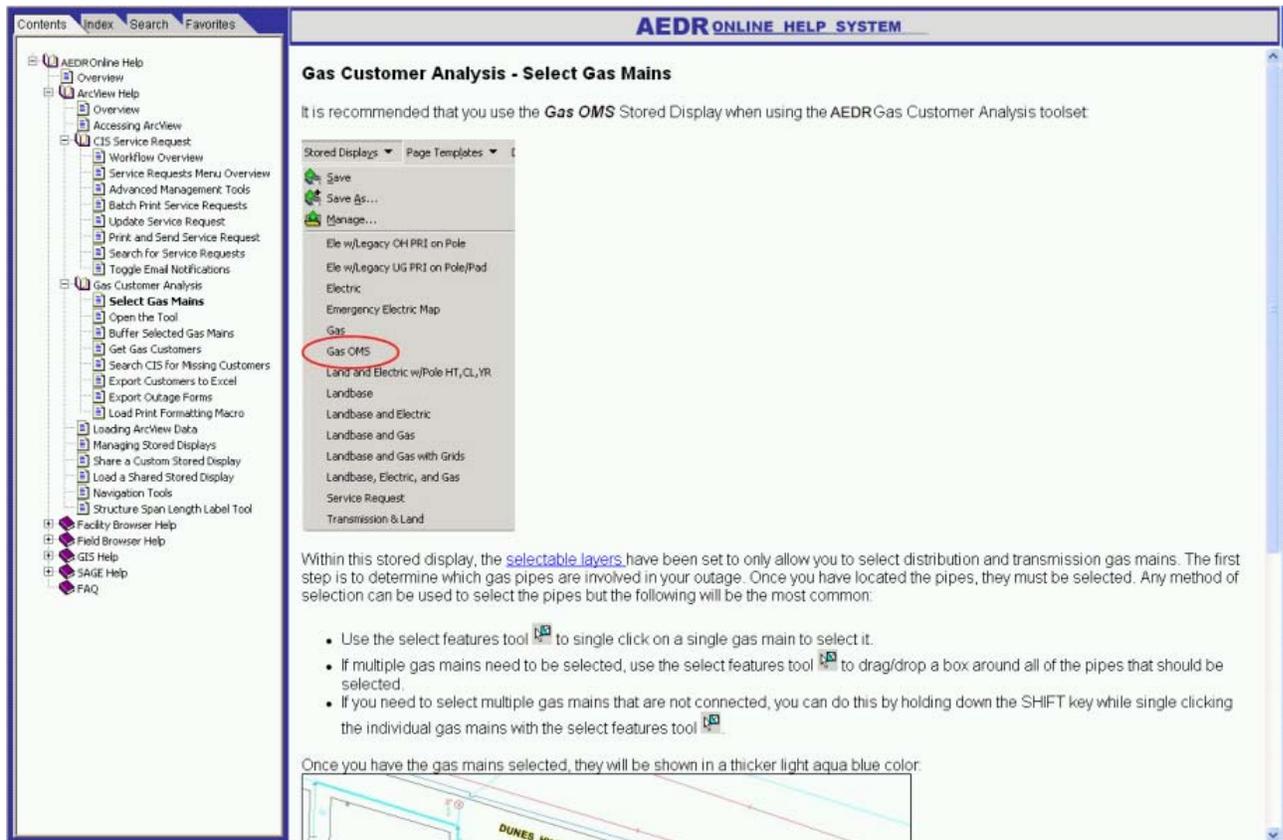
Figure 2.13-22.

The Gas Customer Analysis application was designed specifically with Outage Management in mind and provides critical support to approximately 40 users in that dispatch time is cut substantially and accuracy has improved resulting in a significant increase in customer service.

3 AEDR Interfaces

3.1 Facility Browser Part 2

3.1.1 Overview

The Facility Browser Part 1 addressed the Design Phase of the Facility Browser in the Validation Integration – Results of the Immediate Architecture Implementation. The historical information can be found within the Part 1 design section of the aforementioned report. The Facility Browser implementation into production is described within this report.

As discussed in the Validation Integration – Results of the Immediate Architecture Implementation, the legacy version of Facility Browser, although initially implemented as a query and reporting tool on the web, data entry and edit capability were added along with the creation and maintenance of Gas Service Cards. In the legacy version of Facility Browser the processing was executing on the client, so any of the geoprocessing for analysis of the map data was executing on the user's machine and not the server.

The new version of Facility Browser was designed using ArcIMS as the mapping engine and ArcSDE as the spatial data component. The data connections for querying and reporting on the spatial data, as well as making the various calls to ArcIMS are now designed to use ArcXML. By using ArcXML, interpretation of calls using a connector is unnecessary. The new Facility Browser was developed using ASP.NET in the C#.NET environment. Both HTML and JavaScript continue to be used for the client application. All custom functionality developed for Facility Browser (e.g. Gas Service Card viewer) has been built using C#.NET.

True to the query-only nature of the application, the legacy data entry and edit capability was not implemented in new Facility Browser. Data creation, editing and maintenance are now performed within ArcFM.

The new Facility Browser application uses an ArcIMS Image Map Service. By using the Image Map Service, all of the geoprocessing and querying takes place on the ArcIMS Application/Spatial Server with the results being returned to the end user as a web page.

Figure 3.1-1 shows the main user interface developed for the new Facility Browser:
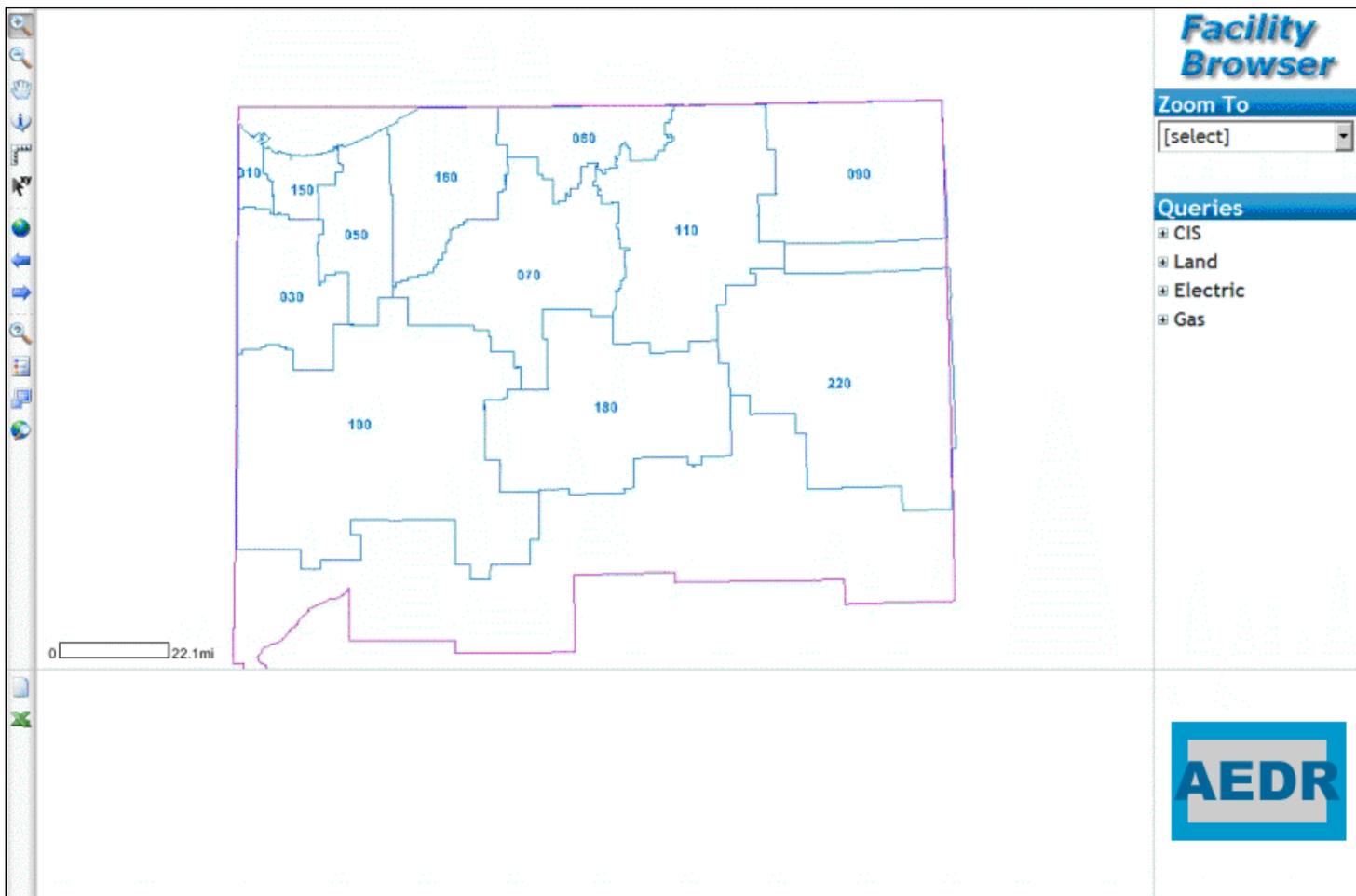
Figure 3.1-1. Facility Browser Main User Interface

3.1.2 Use of ArcIMS

Although the new Facility Browser was designed and implemented using ArcIMS, notably newer technologies have recently evolved providing all of the features of ArcIMS and a wider variety of functionality and ease of use at a lower cost. ArcFM Server running on top of ArcGIS Server is a potential upgrade for the future.

3.1.3 New Application Functionality

As planned in the Design Phase, and shown above in Figure 3.1-1, in the bar left of the map, the new Facility Browser supports the following: Zoom In, Zoom Out, Pan, Identify Map Features, Measure Distance, Get XY Coordinate, View Full Extent, Previous view, Zoom Forward, Bookmark, View Map Legend, Turn On/Off Map Layers, View Map with No Frames and Overview Map. The Overview Map, or Locator Map is shown below in Figure 3.1-2.
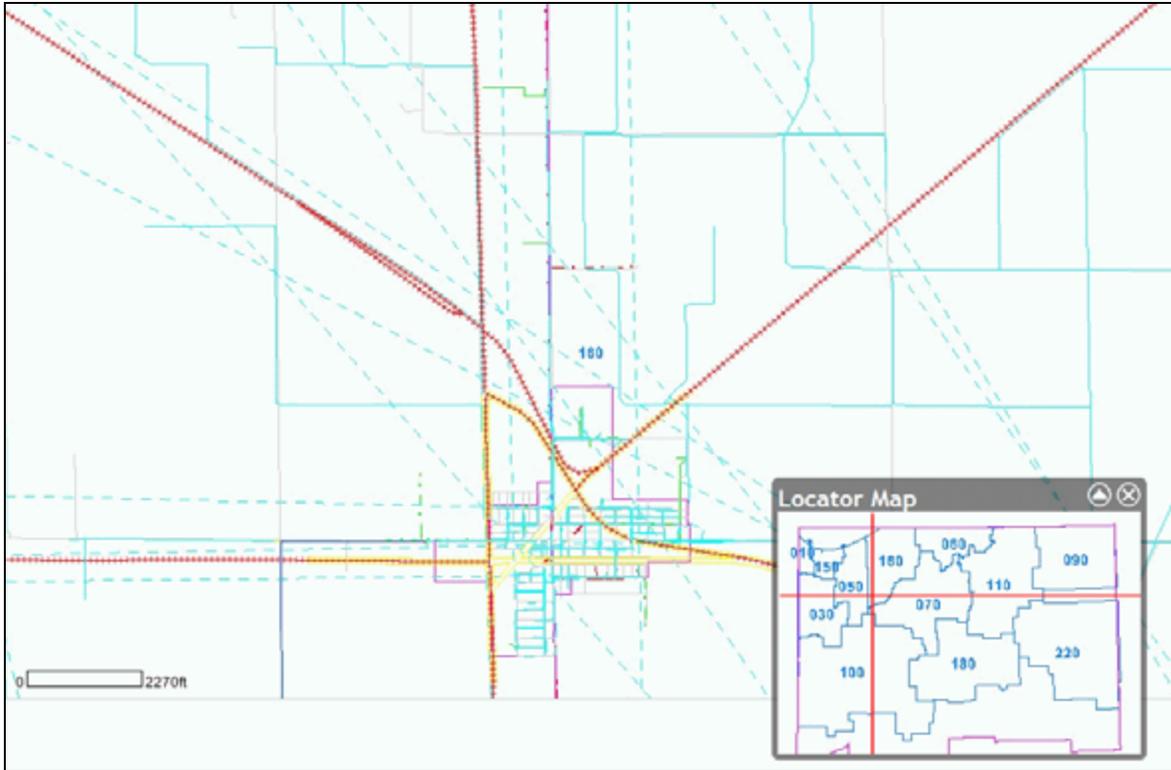
**Figure 3.1-2. Locator map (in lower right corner)
showing the current map location in relation
to the entire NIPSCO service territory.**

Additionally, query capability has been developed for all of the Land, Gas, and Electric Facilities in the Geodatabase as well as Installed Service and Service by Address. Once a set of features has been selected based on the criteria input by the user, a report is generated and the map is zoomed to the extents of the selection set. A user can then zoom to the individual features listed in the report, get more details about a feature, and send the reports to a delimited file for use in Excel.

Figure 3.1-3 shows an example of executing a substation feature query:
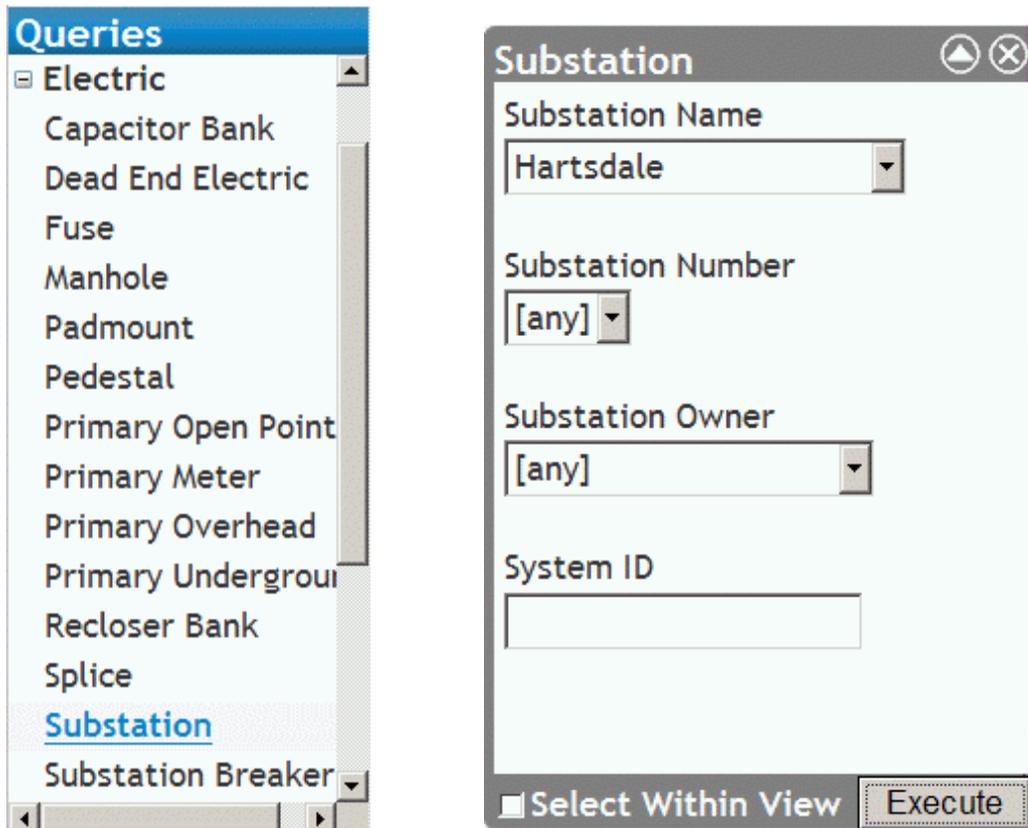
Figure 3.1-3. Query execution.

The matching records are returned in the results grid shown in Figure 3.1-4.

	Substation Name	Substation Number	Substation Owner	System ID	
🔍 ⓘ ⊽	Hartsdale	33	Nipsco Substation	57	
🔍 ⓘ ⊽	Hartsdale	33	Nipsco Substation	58	

Figure 3.1-4. Query results.

Users can perform queries on the Gas & Electric Service Cards to retrieve a list of cards based on an LOA, City, and Street or via the site location. These cards are viewed with the new image browser.

Figure 3.1-5 shows an example of querying a Gas Service Card:

Figure 3.1-5. Query for service cards.

Any matching records are returned in the results grid shown in Figure 3.1-6.

	Site Identification Num...	Service Type C...	Utility Type C...	Meter Num...	Customer Last Name	Customer First
🔍 ⓘ ⚑	28510008	SVC	EL		JONES	RENALDO
🔍 ⓘ ⚑	31874003	SVC	GA	9475374	JONES	JOHN
🔍 ⓘ ⚑	947090002	SVC	EL	0472738	JONES	ELLEN
🔍 ⓘ ⚑	983630004	SVC	EL	0557719	JONES	BRUCE
🔍 ⓘ ⚑	926040003	SVC	GA	9407169	JONES	GARY
🔍 ⓘ ⚑	923850007	SVC	GA	0920473	JONES	JOHN

Figure 3.1-6. Results of query for service cards.

Clicking the links above will launch the new Service Card Viewer shown in Figure 3.1-7.

Figure 3.1-7. Service card.

3.1.4 Placement, Deletion and Editing of the Customer Sites

In the legacy Facility Browser, new customers were managed by storing the site locations as XY coordinates in a flat file. The new data model has a feature class for customers enabling the use of out-of-the-box ArcMap/ArcFM tools to manage the customer sites.

The new Automated Service Request process allows record clerks to import CIS data into the GIS creating a physical location for the CIS installed service. The clerks then create the service request documentation within the AEDR GIS system. The service request is then transferred to engineering for design within an ArcView session. The engineer returns the digital design back to the clerk for as-built updates. After as-built updates, the service request is exported into a PDF format, linked to the installed service feature in AEDR, and linked into the Gas Service Request web viewer (which is an extension of Facility Browser). The Automated Service Request process is discussed in detail in the Customizations section within this report.

3.1.5 Replication of Data

The new Facility Browser accesses ArcSDE to pull both spatial and attribute data. The Facility Browser is a high-volume web application accessed by a growing population of

users across the NIPSCO organization. Because this generates a sizable load on the ArcSDE database server and when combined with the load from ArcEditor and ArcView users, high-volume use of the Facility Browser would have likely caused performance problems. Therefore an additional ArcSDE license and a second production ArcSDE server was purchased and configured to support the Facility Browser application. The data is replicated to the Facility Browser ArcSDE geodatabase on a nightly basis executed via an SQL Server administration script. Separating the two major load components of the AEDR system has provided significant improvements in performance for all system components.

The script performs the following actions:
- Takes a backup (*.bak) of the production ArcSDE database
- Restores the .bak file to the Facility Browser ArcSDE database
- Applies Facility Browser-specific views to allow object table data to be joined directly to feature classes (ArcIMS does not allow the direct viewing of object tables)
- Applies the Facility Browser-specific indexes to improve the ArcIMS performance.

3.1.6 Implementation

Facility Browser was placed into Production in December 2006.

The Implementation tasks were governed by the Deployment Phase II Plan located in Appendix A

All production installations require 100% passing execution of written test cases. The Facility Browser Test Plan is located in Appendix D.

During production rollout, users were trained via multiple instructor-led web conferencing sessions. The two main user groups, Records and Engineering were initially trained followed by many smaller group training over a 3 week period until all users completed the training mid-January 2007. Additionally, Facility Browser navigation and user instruction was added to the AEDR Online Help system to augment the training. See Figure 3.1-8.
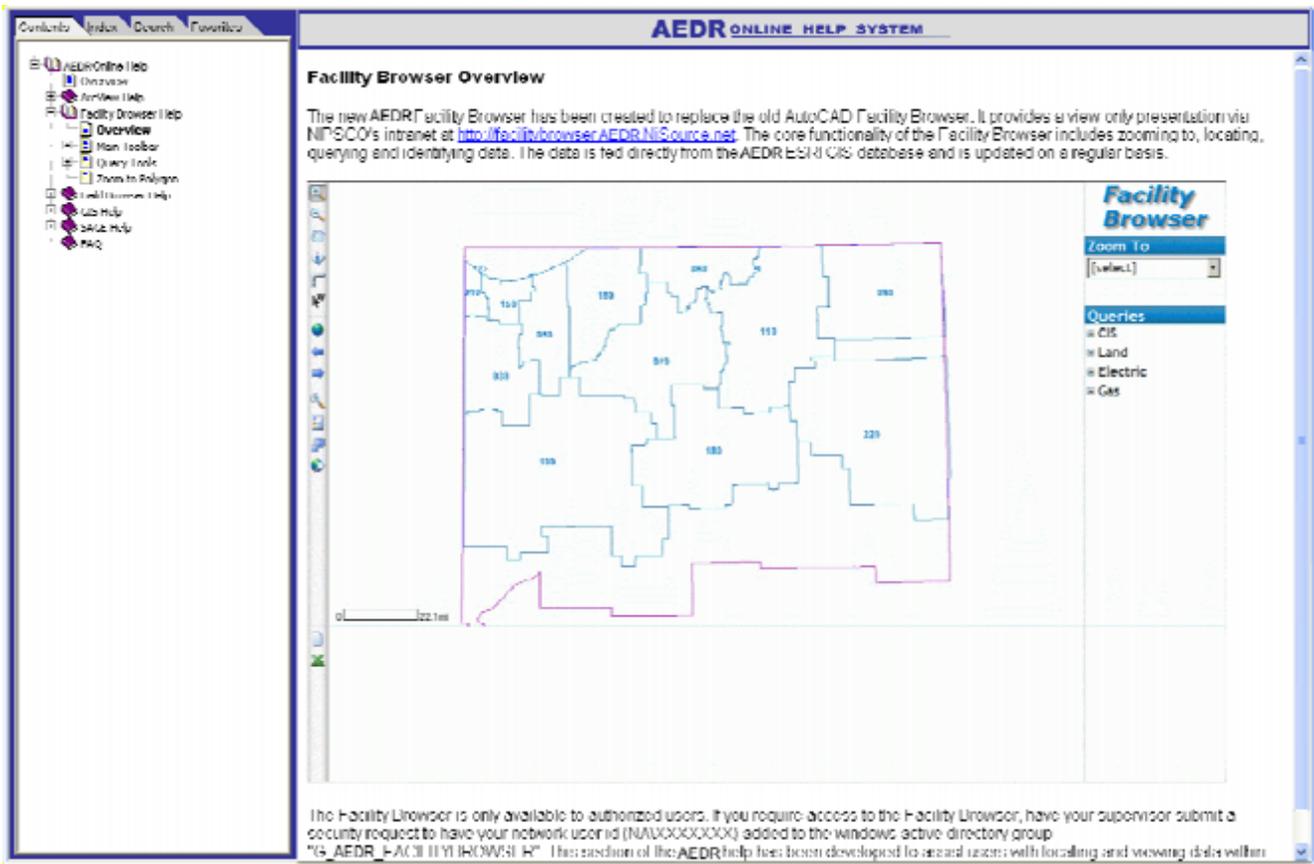
Figure 3.1-8. Facility Browser online help.

The Facility Browser is a widely-used application supporting in excess of 340 users and growing weekly. An increasing number of users are becoming aware of the capabilities and potential of a web-based, easy-to-use tool to obtain spatial facility information.

Distribution and Transmission Engineering, Locate Screening, Forestry, Records, Field Operation Supervisors, Gas Systems Operations, Construction and Maintenance, Engineering Standards, Substation Scheduling, Gas Systems Planning, Recovery and Damage Prevention, Electric Distribution Systems Resource Management, Asset Accounting, Gas Operations Integration, FERC/NERC Compliance & Training, Electric Reliability and Metering, Major Accounts, and a few other areas rely on and benefit from the Facility Browser component.

3.2 Field Browser Part 2

3.2.1 Overview

The Field Browser Part 1 encompassed the design phase of the Field Browser in the Validation Integration – Results of the Immediate Architecture Implementation. The historical information is provided within the Part 1 design of the aforementioned report. The Field Browser production implementation is described within this report.

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The Field Browser is used both in the office and by field personnel. It is a self-contained (client-side) installation of the AEDR data and an ESRI viewer (ArcReader) that does not require a software license or network connection. The legacy Field Browser application solution had performed well for several years and the main goal of the new Field Browser implementation was to match or exceed the legacy functionality on the new ESRI platform.

Figure 3.2-1 shows the default interface for the new Field Browser.

Figure 3.2-1. Field Browser main user interface

3.2.2 Requirements

The following requirements for the new Field Browser intent on replacing the current functionality have been met:

- The end user is able to view all the facilities within the NIPSCO service area. The system provides the Gas Street, Line, Service Personnel, Corrosion Control,

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Facility Locating Contractors, Forestry Operations (and many more) with electronic field access.

- The Field Browser provides a legend of the facilities including a description name.
- Mapping tool functionality including pan, zoom window, zoom in/out, zoom full extents, zoom previous, and zoom forward have been provided.
- The end user is able to pull up the extents of any of NIPSCO's Local Operating Areas (LOA's).
- The end user has full viewing control of facilities.
- The Field Browser provides full query access to the facility data by using any of the following fields: Street Intersection, Pole, Switch, Substation, Transformer Number, Pad Number, Regulator Station, Emergency Valve, Valve, and Corrosion Control Section.
- The end user can view facilities seamlessly.
- The Field Browser will load and open with minimal delay.
- The Field Browser provides a tool to view electric and gas facilities over the top of an accurate land base.
- The Field Browser provides the ability to query based on certain facility information including pole number, regulator station number, substation name, pad number, valve number, street intersection, etc.
- The capability to view an entire LOA, seamlessly, without the need to jump from map to map has been provided.

Figure 3.2-2 shows the standard ArcReader "Find" window which will be used to query the AEDR assets.
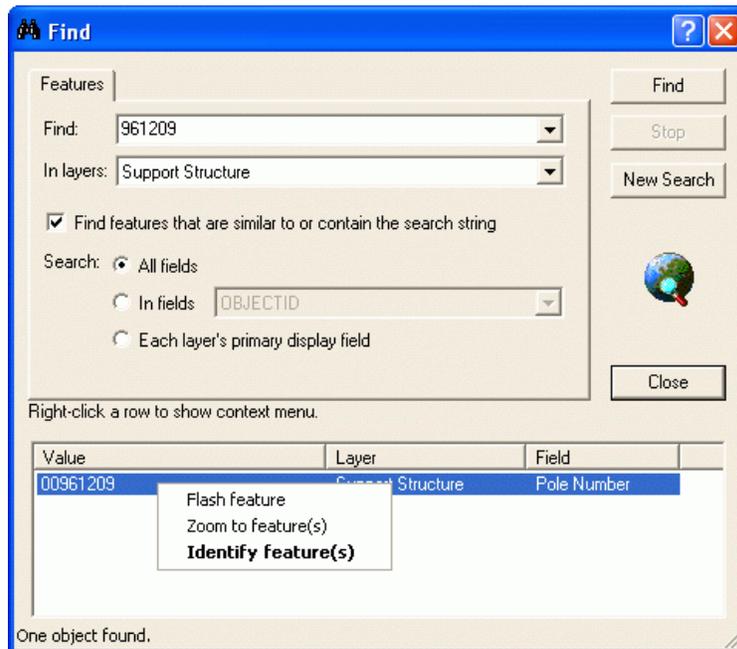
Figure 3.2-2. Query window to locate the assets.

3.2.3 New Features Implemented

The most notable feature for the new Field Browser is the MS Explorer style view of the application. This feature is important because it allows the GIS team to manage the layers into data frames or groups. By creating groups like "electric", "gas" and "land", a user on the gas side of the company can easily toggle off the electric and or land facilities. It also provides the ability to turn individual layers on/off.

The background color of the new Field Browser has been changed to white instead of the legacy black background. The new application continues to run on the existing Field Browser laptop computers. Performance evaluations ensured the current hardware supports the new Field Browser application. Although performance is slightly slower, ArcReader compensates by providing a comprehensive set of tools to view and query the data as well as a fairly customizable user interface that will allow different users to have individualized views of the data, benefits far outweighing the minor performance degradation.

3.2.4 Street Centerline Intersection Queries

A landbase feature class "StreetCenterlineIntersections" exists in the back office and defines spatial points at the intersection of all street centerline features. Each point tracks the attribution as shown in Figure 3.2-3.

Field Name	Data Type
NAME1	Text
NAME2	Text
ZIPCODES	Text
XCOORD	Double
YCOORD	Double
ROADNAME	Text
SHAPE	Geometry

Figure 3.2-3. Attribution of street centerlines.

Most of these attributes are used for system purposes but the Name1 and Name2 fields will allow querying the AEDR for street intersections such as "Main" and "Broadway" or any other combination. A spatial location is returned and the user can then zoom directly to the intersection of the specified streets. This works very well for all of the back office applications including ArcGIS, ArcView, and Facility Browser. However, ArcReader only allows a query on a single field so inputting both a Name1 and a Name2 was not an option. Street intersection searches are crucial to field users so a light-weight Windows application was developed in order to maintain the functionality.

Figure 3.2-4 shows the new light-weight windows application, "AddIntersectionToStreetIntersections". It contains a single prompt that allows the Field Browser to input a UNC path to the personal geodatabase where the extracted StreetCenterlineIntersections feature class resides.

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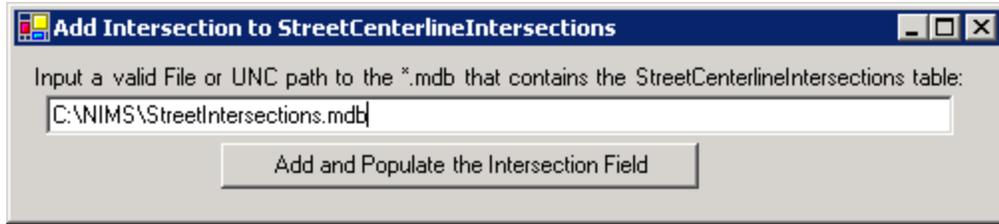
Figure 3.2-4. Street centerline intersection query.

When the "Add and Populate the Intersection Field" button is clicked, the process accesses the StreetCenterlineIntersections table to check for the existence of an "Intersection" column. If it is not found, the application will automatically add this column to the table. The process concatenates the values for Name1 and Name2 with an "&" in between and subsequently loads this concatenated value into the Intersection column for all StreetCenterlineIntersections records. Querying is made possible on the single Intersection field with a parameter such as "Regency & 18th" as shown in Figure 3.2-5.
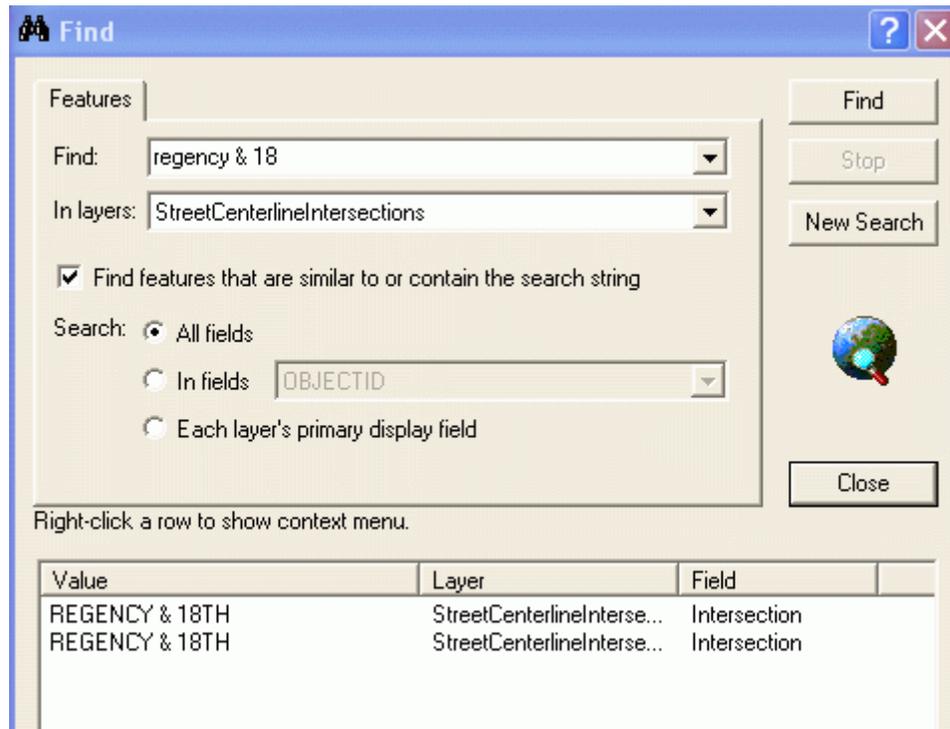
Figure 3.2-5. Street centerline intersection query.

This solution solves the problem and allows the field users to utilize the StreetCenterlineIntersections table in a very similar manner to back office users.

3.2.5 Exporting the Data

Exporting a file geodatabase is the chosen method for monthly data updating of the Field Browser laptops

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An ArcMap (.mxd) file is created by saving a copy of the production SDE database. Configuration and symbology maintenance are performed on certain features within the database. Once the NewFB.mxd has been created, the file geodatabase is exported monthly via CD media. The export steps below can be adapted to any export process; Land was used for this example:

1.   Log on to the Test Citrix box and start up ArcCatalog.

2.   Using the Explorer in ArcCatalog, (see Figure 3.2-6) go to D:\FieldBrowser and Delete any File Personal Geodatabases.
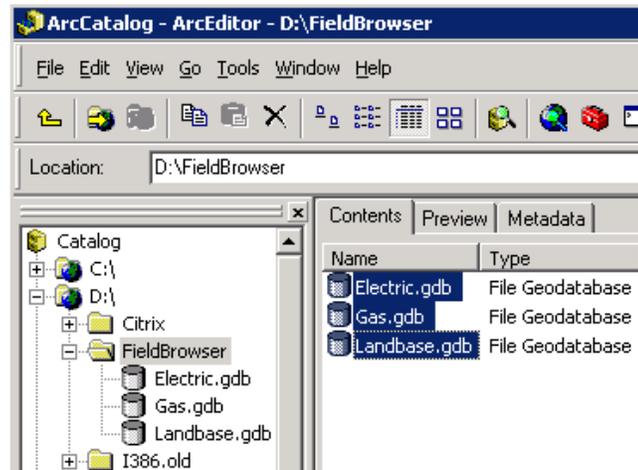
Figure 3.2-6.

3.   Right-Click on the Field Browser folder (see Figure 3.2-7) and select New -> File Geodatabase. The first file geodatabase name will be Landbase. Repeat this for the Gas and the Electric.

Figure 3.2-7.

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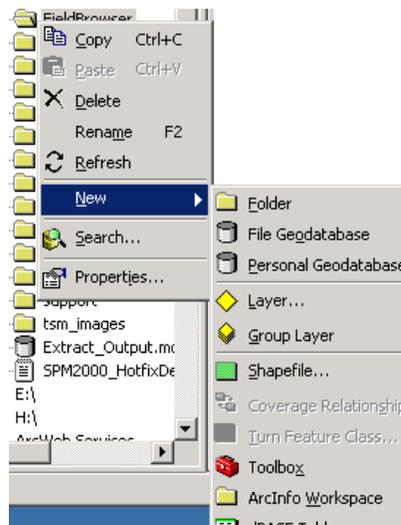
4.   Go to the Database Connections, expand it and create a link to the production database. Log in as Landbase for the Landbase database creation, log in as Gas for the Gas database creation or log in as Electric for the Electric database creation.

LANDBASE *******************

5.   Log into the Production Database as Landbase. Right-Click on the Landbase dataset and select Copy as shown in Figure 3.2-8.

Figure 3.2-8.

6.   Explorer back to the Personal geodatabase created at D:\FieldBrowser\, right click on Landbase.gdb and select Paste (see Figure 3.2-9).

Figure 3.2-9.

7.   A Data Transfer dialog box will appear as shown in Figure 3.2-10, click OK. This process will need to be repeated for the Gas and Electric. Close ArcCatalog once the copying is complete. Reopen ArcCatalog and the Production database, logging in as Gas or Electric and Repeat the step.
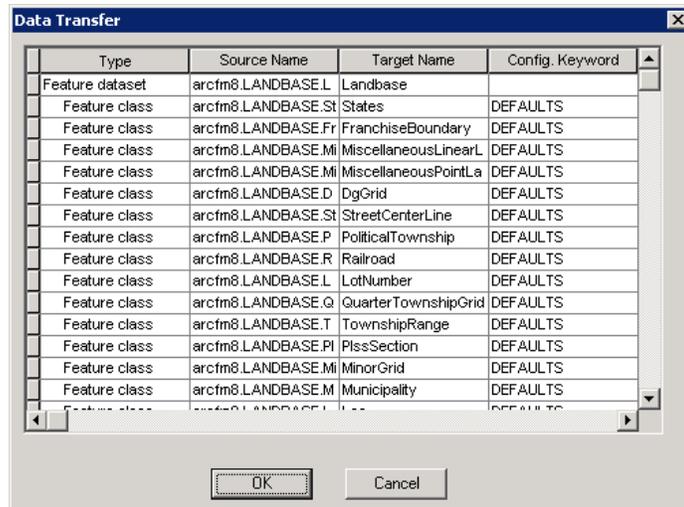
Figure 3.2-10.

8.	Figure 3.2-11 shows the Data Transfer process beginning. Each of the 3 transfers (landbase, gas and electric) will take between 20-30 minutes to copy over (for a database the same size as NIPSCO).
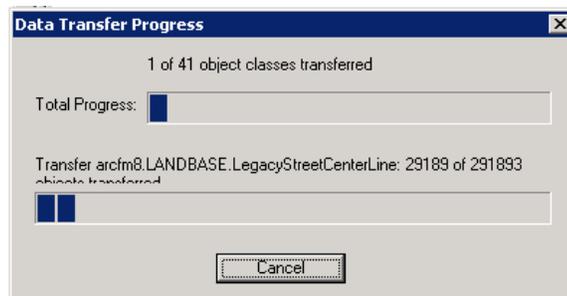
Figure 3.2-11.

9.	Once the process has completed, Right-Click on the Landbase File Geodatabase and select Create ArcFM Solution System Tables as shown in Figure 3.2-12.
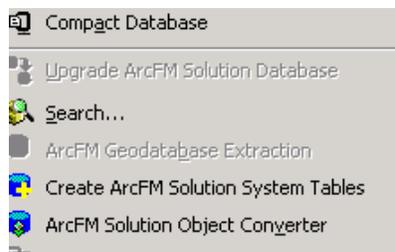
Figure 3.2-12.

10.	An ArcFM Info Log window (Figure 3.2-13) will open, select OK.

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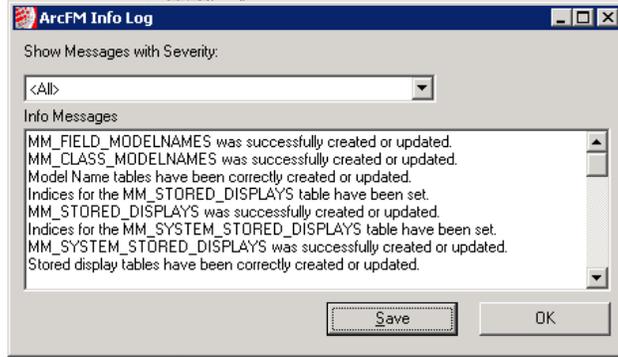
Figure 3.2-13.

11. Refresh the Landbase File Geodatabase, Right-Click on the Landbase and select Upgrade ArcFM Solution Database as shown in Figure 3.2-14.
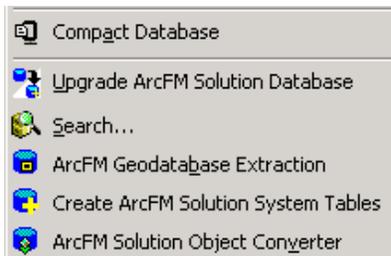
Figure 3.2-14.

12. Select Yes when prompted with the Figure 3.2-15 dialog box:
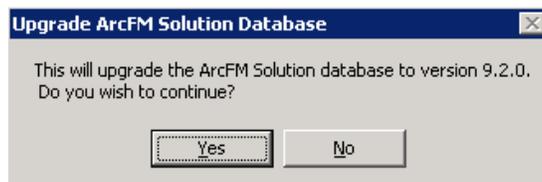
Figure 3.2-15.

13. Click OK.

Figure 3.2-16.

14. Right-Click on the Landbase File Geodatabase and in Figure 3.2-17, select ArcFM Solution Object Converter.
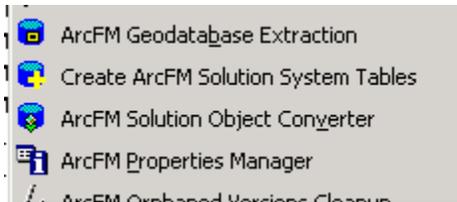
Figure 3.2-17.

15. Select Convert to use ESRI objects. Click OK.

Figure 3.2-18.

16. Select Yes.

Figure 3.2-19.

17. Click OK

Figure 3.2-20.

18. As shown in Figure 3.2-21, remove any tables and relationships copied to the File Geodatabase using ArcCatalog.
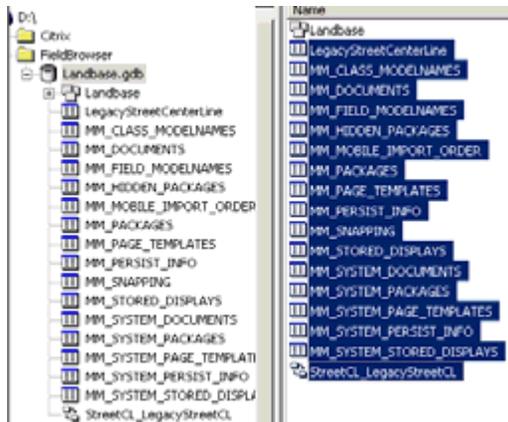
Figure 3.2-21.

19. Open the dataset and remove any Annotation relationships.

Figure 3.2-22.

20. Cut & Paste all the features and the annotation out of the Landbase dataset to the root of the File Geodatabase and delete the Landbase dataset.
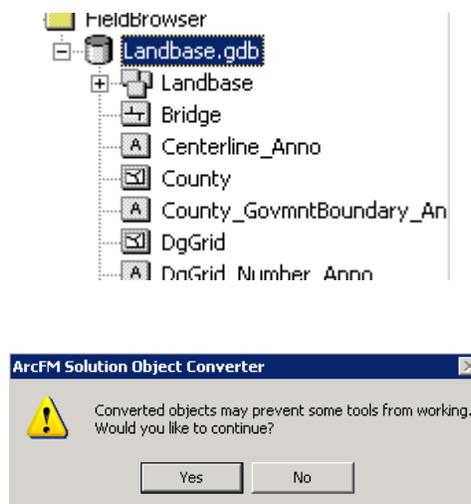
Figure 3.2-23.

21. Compact the Landbase File Geodatabase. Close ArcCatalog. Repeat for Gas and Electric.

22. In Explorer Create a folder called c:\FieldBrowser. Copy the three File Geodatabases to this location.

ADD INTERSECTION TO STREET CENTERLINE INTERSECTIONS**********

23. Run the AddIntersectionToStreetIntersection.exe to Landbase.gdb and click Add and Populate the Intersection Field as shown in Figure 3.2-24.
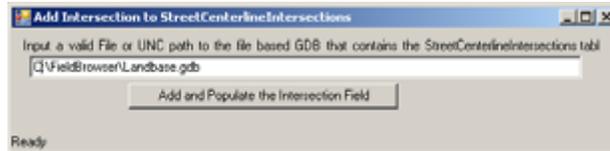
Figure 3.2-24.

24. Click OK.

Figure 3.2-25.

25. Open ArcCatalog and Compact the Landbase File Geodatabase.

CREATE THE .PMF FILE *******************

26. Get the latest file FieldBrowser.mxd located at NIPSCO GIS\Software Development\Field Browser\MXD. Copy the file to c:\FieldBrowser. Open the file.

27. Load the Publisher Toolbar.

Figure 3.2-26.

28. Go to the Publisher dropdown on the toolbar and select Settings. In the Contents tab shown in Figure 3.2-27, "Include all layers" and "Data view and Layout view". In the Functionality tab uncheck Hyperlink. Click OK.
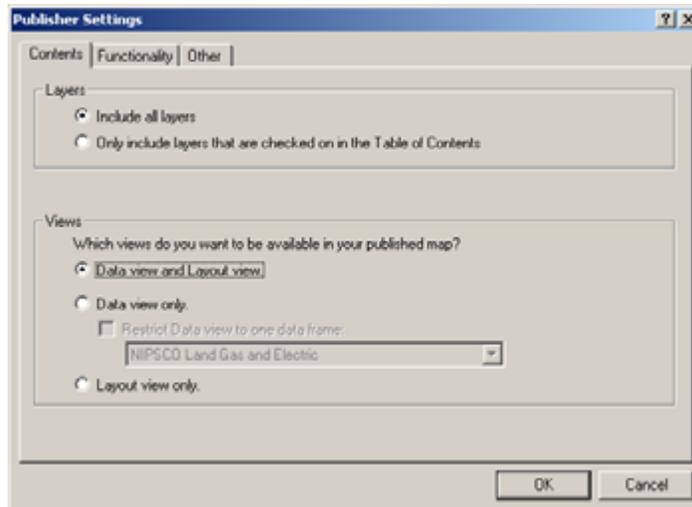
Figure 3.2-27.

29. Click the Publish Map Button and Name the file FieldBrowser.pmf and save to C:\FieldBrowser as shown in Figure 3.2-28.
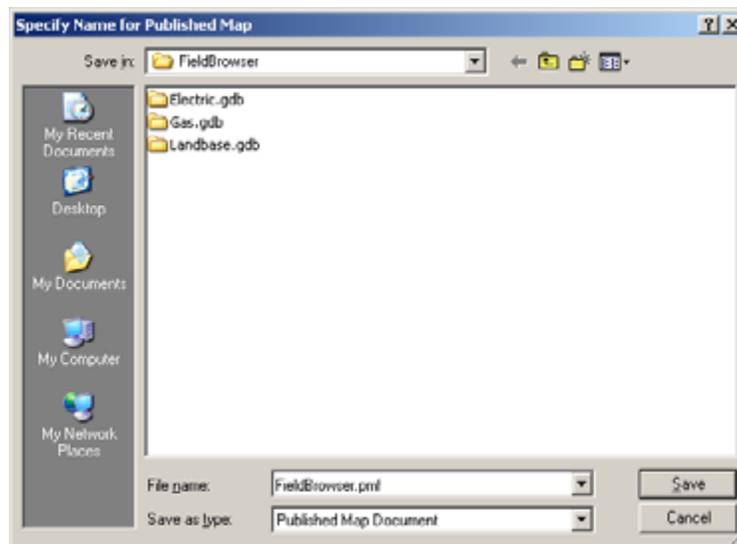
Figure 3.2-28.

CREATE THE SELF-EXTRACTING .EXE *******************

30. Zip up the folder c:\FieldBrowser. The only files should be the 3 databases in the PersonalGDB folder and FieldBrowser.pmf in the root of Field Browser.

31. Right-Click on FieldBrowser.zip and select Winzip->Create Self-Extactor (.Exe)
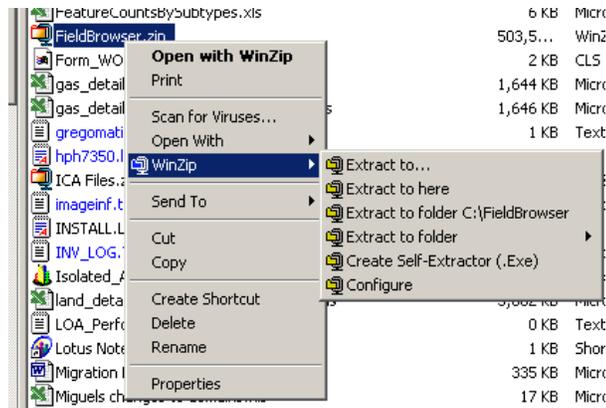
Figure 3.2-29.

32. The window in Figure 3.2-30 will appear, click OK.
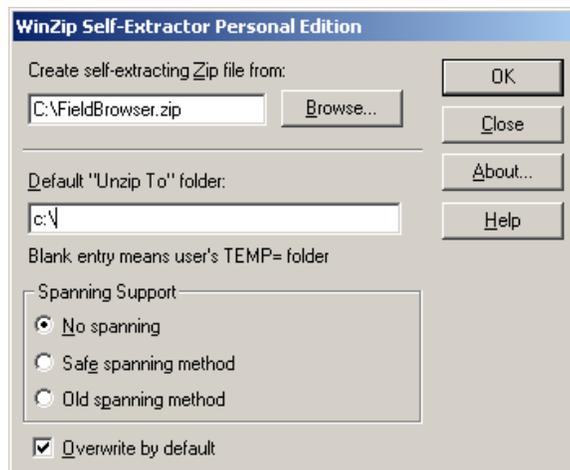
Figure 3.2-30.

CREATING THE AUTORUN CD ********************

33. Burn a data CD with the new created FieldBrowser.exe and AutoRun.ini.

The use of the pGDB Field Stripper was determined to be unnecessary as the file size was small enough to fit on one CD.

3.2.6 Implementation

The legacy Field Browser resided on 6-year old laptops that were being used in the field. This made a strong case for replacing the laptops with new hardware at the same time the new application was implemented as the old laptops were beginning to fail in the field. Over a period of 3 weeks and with support from Information Technology, 250 newer laptops were obtained and built with a locked-down image. Subsequently, the new Field Browser application and updated cut of data was loaded on the new laptops.

Production implementation began October 2006 and ended in December 2006. During user training, the rollout was transitioned into production over a period of three months in order to swap out the old laptops with the new laptops while at the same time training the 470 users with just one training resource. The process was well planned out and very successful.

The Implementation tasks were governed by the AEDR Field Browser Implementation Plan located in Appendix E.

All production installations require 100% passing execution of written test cases. In this instance, both the application and the new laptops were acceptance tested to verify that the replacement functionality meets the planned implementation and that the Field Browser imaging was correctly installed on each new laptop. Upon successful execution of the test plan (located in Appendix F), the functionality and laptop is deemed ready for production.

The Field Browser replacement functionality is a migration of the base software architecture from Autodesk's VoloView to ESRI's ArcReader.

While progressing through the "Field Browser Hardware-Data-Application Test" for each laptop, the Tester writes a "P" or an "F" in the yellow box next to the test. The "Fail" box is checked if there are any failing steps and the laptop build is put in the reject pile for rebuild. All of the 250 laptops received a "Pass" so none of the laptops required a rebuild. There were however, five dead batteries found during the charge-up process that required replacement.

Field crew training was provided in an instructor-led, classroom-style setting with hands-on training using the new, fully configured laptops. Field Browser navigation and user instruction was added to the AEDR Online Help system to augment the training. See Figure 3.2-31.
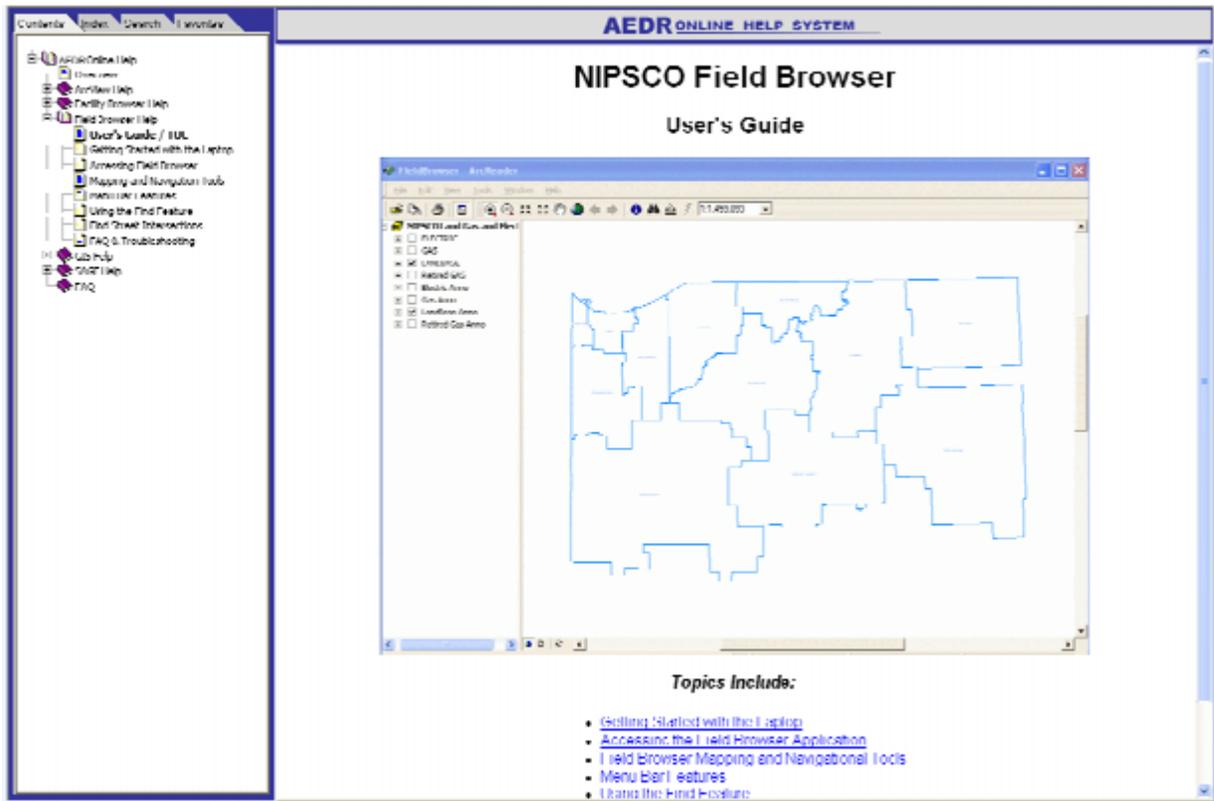
Figure 3.2-31. Field Browser online help.

The Field Browser is a popular application supporting approximately 476 users, and growing monthly. The latest addition to the family of Field Browser users is Forestry Operations where the Field Browser application was installed on 8 laptops to aid in vegetation management.

Among the Field Browser users are: Field Operations, Gas Systems Planning, Construction, Electric Distribution Systems Resource Management, Gas Systems Operations, Gas Meter Management, District Engineering, Transmission Planning Systems & Protection, Gas Transmission & Distribution , Damage Prevention, Electric Standards, Budget, Compliance & Training, Electric Transmission Maintenance, Electric Substation, Support Operations, Aviation Services, Engineering Services, Power Quality, Relay and Control, Regulation and Communications (Auburn), Plant Operations (Kokomo), SM&P Locating, Henkles & McCoy, Arbormetrics and Forestry Operations.

3.3 CADOPS/FeederAll Part 2

3.3.1 Overview

The Phase I report, Validation Integration – Results of the Immediate Architecture Implementation document provided the design for this interface. The detailed configuration and operations for the ABB CADOPS and FeederAll interface is described within this report.

Although FeederAll Part 2 has been installed as designed, configuration and operations remain outstanding pending user availability. This document is written with references to FeederAll with assumption that FeederAll will become activated sometime in 2008.

To use the interface, an ArcFM session must be started within ArcGIS. Within the ArcFM session, the desired features are selected using any of the ArcFM / ArcMap tools (including select by attributes, select by Feeder, trace tools, rubber band selection, etc). The user opens the ArcFM Network Adapter toolbar and clicks either the CADOPS or the FeederAll export button. The system exports the selected features into the Network Adapter XML file based on the configured Network Adapter class and field model names. The system then transforms the XML via XSLT into the CADOPS and FeederAll comma-delimited file formats that are used by the current system. The user loads the comma-delimited files into their respective Oracle databases using Oracle SQL Loader. The CADOPS and FeederAll interface process continues using the legacy post-processing techniques and algorithms.

3.3.2 ArcFM Catalog Configuration

The ArcFM Properties Manager within ArcCatalog was used to configure the feature classes and fields that are exported by Network Adapter into the un-transformed XML file. These fields are then parsed and formatted by the XSLT transformation into the desired CSV format. Adding the configuration via the ArcFM Properties Manager alone will not result in the fields being added to the ABB CSV files. Additional configuration/code must be included in the XSLT to accomplish this task. This section of the document outlines the steps to configure the AEDR Network Adapter export within ArcCatalog.

3.3.3 Model Name Domain Configuration

These Model Name Domains in Figure 3.3-1 were created specifically for the Network Adapter - CADOPS interface and were created with the listed Model Names. Other applications may have added to them, but their origin began with the Network Adapter – CADOPS interface.

Model Name Domain	Model Name
Network Adapter Object Class Model Name	CADOPS
Network Adapter Object Class Model Name	FEEDERALL
Network Adapter Object Class Model Name	NABACKWARD
Network Adapter Object Class Model Name	NAGETSHAPE
Network Adapter Field Model Name	CADOPS

Network Adapter Field Model Name	FEEDERALL

Figure 3.3-1.

These Model Names are added within ArcCatalog by right clicking on the database and choosing Properties. This will bring up the Database Properties dialog shown in Figure 3.3-2, which includes a Domains tab:
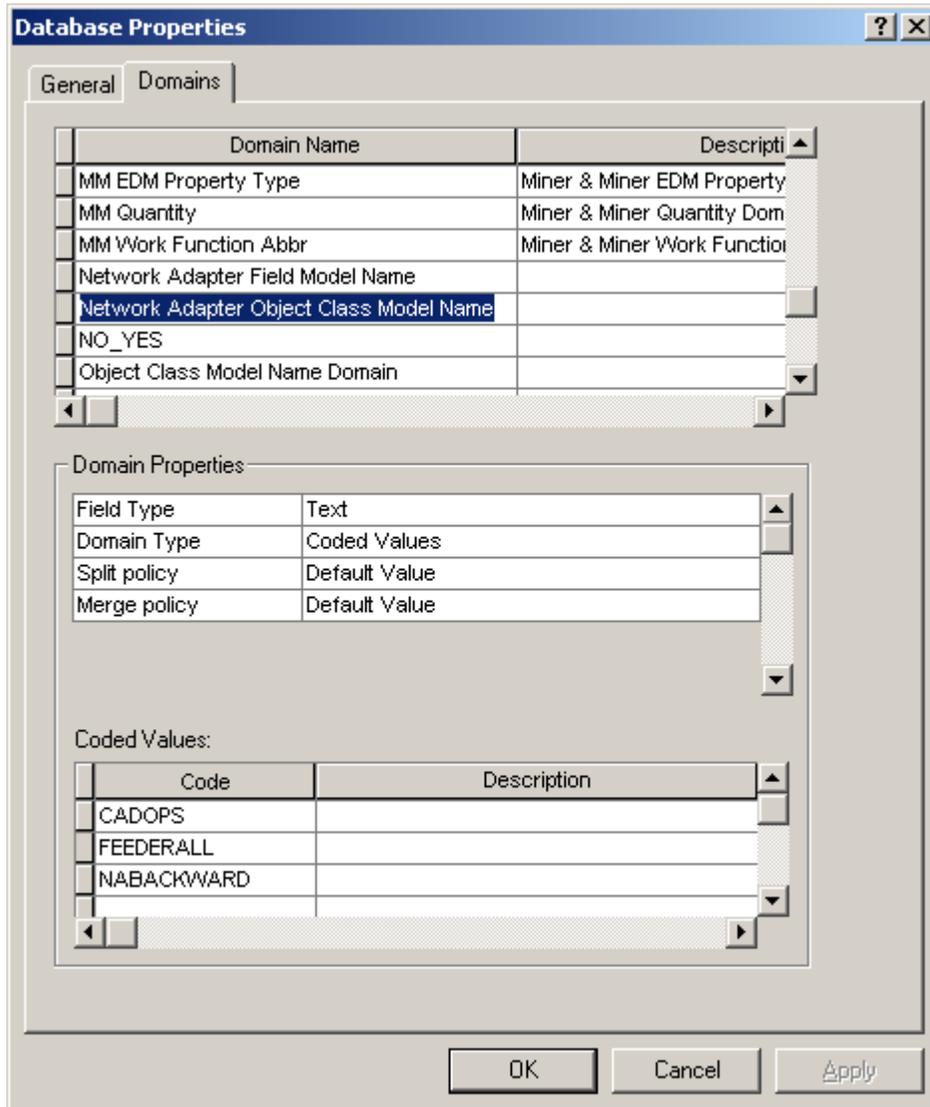
Figure 3.3-2.

The user creates two new domains called "Network Adapter Object Class Model Name" and "Network Adapter Field Model Name". The model names from Figure 3.3-1 are then added to their respective domains in Figure 3.3-2.

The next configuration step allows ArcFM to recognize the new domains as configurable Model Name Domains. Within the same dialog referenced above, the "Object Class Model Name Domain" domain is located and "Network Adapter Object Class Model Name" is added to it as shown in Figure 3.3-3.
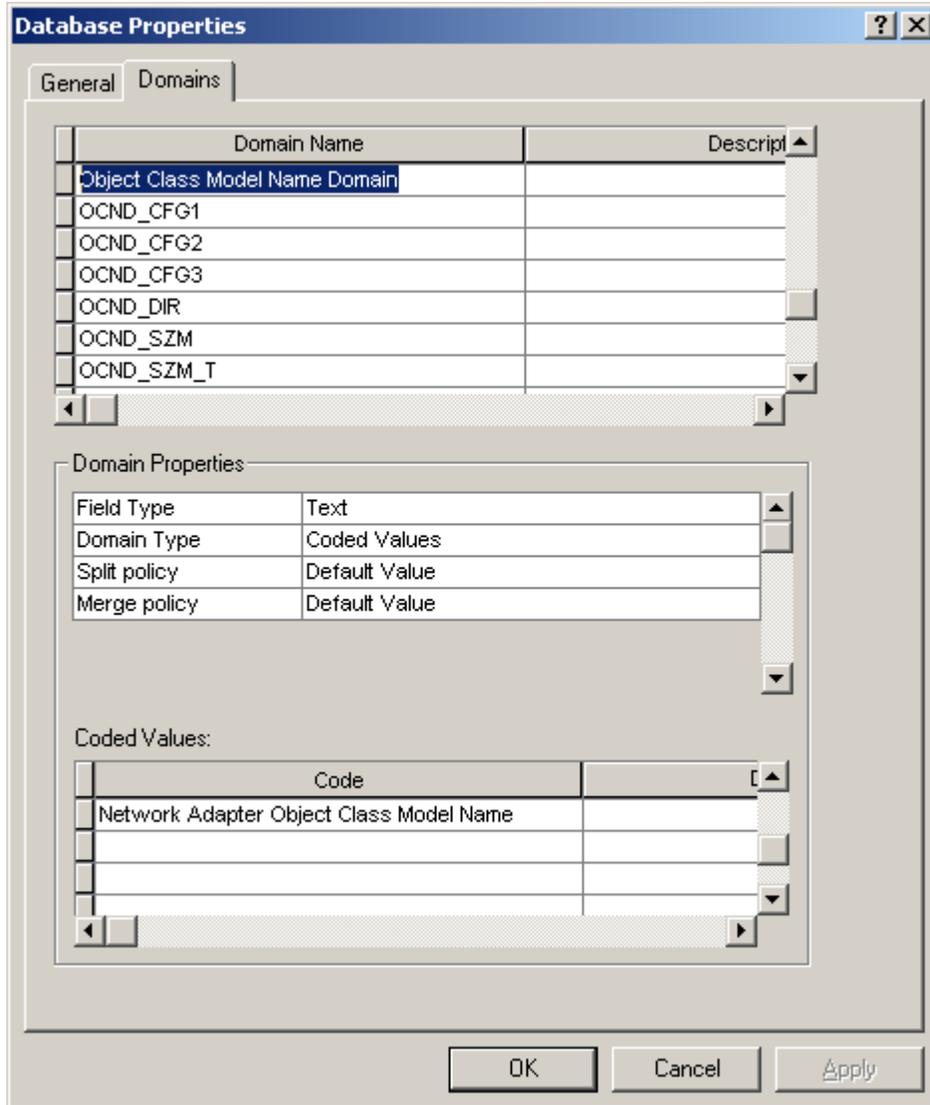
Figure 3.3-3.

Next, the "Field Model Name Domain" within the domain is located and "Network Adapter Field Model Name" is added to it as shown in Figure 3.3-4.
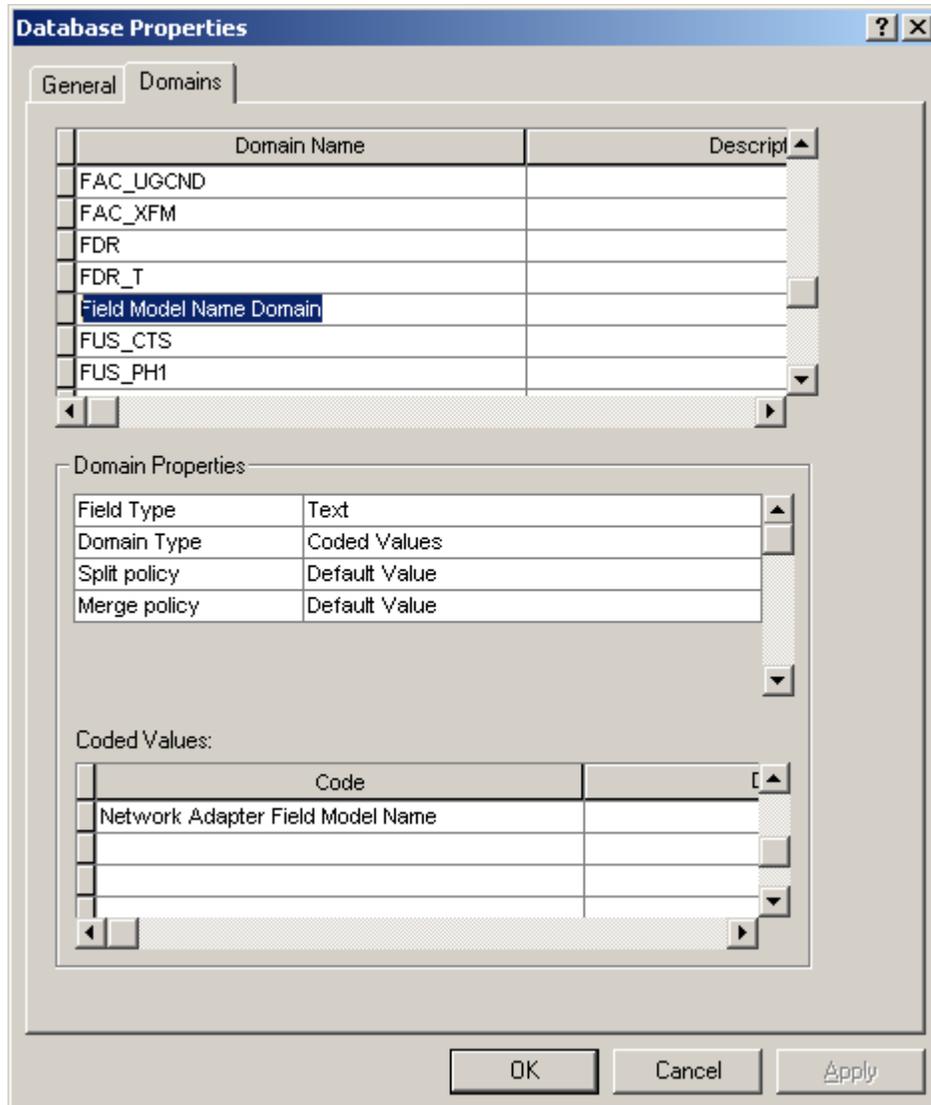
Figure 3.3-4.

At this point, the configuration of the Model Name domains is complete. The next steps involve associating these Model Names with the various object classes and fields that should be exported as part of the ABB export.

3.3.4 ArcFM Properties Manager Configuration

The following list defines the feature/object classes and their fields that must be configured with the ArcFM Model Names outlined in the previous section:

CapacitorBank [CADOPS, FEEDERALL]
CapacitorTypeCd [CADOPS, FEEDERALL]
SubtypeCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]

PhaseDesignationCd [CADOPS, FEEDERALL]
BankKVarValue [CADOPS, FEEDERALL]

CapacitorUnitInstall [CADOPS, FEEDERALL]
PhaseDesignation [CADOPS, FEEDERALL]
KvarValue [CADOPS, FEEDERALL] → CapacitorUnit->CapacitorStoresItem->KvarValue

CapacitorUnit [CADOPS, FEEDERALL, NABACKWARD]

CapacitorStoresItem [CADOPS, FEEDERALL, NABACKWARD]
KvarValue [CADOPS, FEEDERALL]

CircuitSource [CADOPS, FEEDERALL]
NominalVoltage [CADOPS, FEEDERALL]
ID [CADOPS, FEEDERALL] → CIRCUITSOURCEID
Name [CADOPS, FEEDERALL] → CIRCUITSOURCENAME
SubstationId [CADOPS, FEEDERALL]
EmergencyCapacityKW [CADOPS, FEEDERALL]
MaxKVAR [CADOPS, FEEDERALL]
MinKVAR [CADOPS, FEEDERALL]
MaxPositiveSequenceReactance [CADOPS, FEEDERALL]
MaxPositiveSequenceResistance [CADOPS, FEEDERALL]
MaxZeroSequenceResistance [CADOPS, FEEDERALL]
VoltageAngle [CADOPS, FEEDERALL]
NegativeSequenceReactance [CADOPS, FEEDERALL]
MaxZeroSequenceImpedance [CADOPS, FEEDERALL]

CustomerGenerator [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
NormalPositionA [CADOPS, FEEDERALL]
NormalPositionB [CADOPS, FEEDERALL]
NormalPositionC [CADOPS, FEEDERALL]
CustomerName [CADOPS, FEEDERALL]
NominalVoltage [CADOPS, FEEDERALL]
CustomerSubstationId [CADOPS, FEEDERALL]
MaxPositiveSequenceResistance [CADOPS, FEEDERALL]
MaxPositiveSequenceReactance [CADOPS, FEEDERALL]
NegativeSequenceReactance [CADOPS, FEEDERALL]
MaxZeroSequenceReasistance [CADOPS, FEEDERALL]
MaxZeroSequenceImpedance [CADOPS, FEEDERALL]
MaxKVar [CADOPS, FEEDERALL]
MinKVar [CADOPS, FEEDERALL]

ElectricNetwork_Junctions [CADOPS, FEEDERALL, NAGETSHAPE]
Enabled [CADOPS, FEEDERALL]

FeederAllOpenPoint [FEEDERALL]
ENABLED [FEEDERALL]

FuseCutoutBank [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
FeederID [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
NormalPositionA [CADOPS, FEEDERALL]
NormalPositionB [CADOPS, FEEDERALL]
NormalPositionC [CADOPS, FEEDERALL]
FuseLinkAmpRatingValue [CADOPS, FEEDERALL]

OhConductor [CADOPS, FEEDERALL]
SubtypeCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
MeasuredLength [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PrimaryOperatingVoltageValue [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
WireSizeCd [CADOPS, FEEDERALL]
WireMaterialCd [CADOPS, FEEDERALL]

OhConductorInfo [CADOPS, FEEDERALL]
SubtypeCd [CADOPS, FEEDERALL]
ConductorSizeCd [CADOPS, FEEDERALL] → WIRESIZECD
ConductorMaterialCd [CADOPS, FEEDERALL] → WIREMATERIALCD
ConductorTypeCd [CADOPS, FEEDERALL] → WIRETYPECD

OpenPoint [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
NormalPositionA [CADOPS, FEEDERALL]
NormalPositionB [CADOPS, FEEDERALL]
NormalPositionC [CADOPS, FEEDERALL]

PadMount [CADOPS, FEEDERALL, NABACKWARD]
DISTRIBREFNUMBER [CADOPS, FEEDERALL]

PowerTransformer [FEEDERALL, NAGETSHAPE]
None

PrimaryMeter [CADOPS, FEEDERALL, NABACKWARD]
SubtypeCd [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]

RecloserBank [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
LoadNumber [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
RecloserTypeCd [CADOPS, FEEDERALL]
RecloserSizeValue [CADOPS, FEEDERALL]
NormalPositionA [CADOPS, FEEDERALL]
NormalPositionB [CADOPS, FEEDERALL]
NormalPositionC [CADOPS, FEEDERALL]

SectionalizerBank [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
NormalPositionA [CADOPS, FEEDERALL]
NormalPositionB [CADOPS, FEEDERALL]
NormalPositionC [CADOPS, FEEDERALL]
FuseIdNumber [CADOPS, FEEDERALL] → SECTIONFUSENUMBER
SectionalizerAmpRating [CADOPS, FEEDERALL]
# of related Units

SectionalizerUnit [CADOPS, FEEDERAL]
OBJECTID [CADOPS, FEEDERALL]

Switch [CADOPS, FEEDERALL]
SubtypeCd [CADOPS, FEEDERALL]
SwitchIdNumber [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
NormalPositionA [CADOPS, FEEDERALL]
NormalPositionB [CADOPS, FEEDERALL]
NormalPositionC [CADOPS, FEEDERALL]

SwitchUnit [CADOPS, FEEDERALL]
SwitchAmperageValue [CADOPS, FEEDERALL]

Substation [CADOPS, FEEDERALL, NABACKWARD]
SubstationNumber [CADOPS, FEEDERALL]

SubstationBreaker [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
NormalPositionABC [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
NominalVoltage [CADOPS, FEEDERALL] → get from CIRCUITSOURCE
MaxPositiveSequenceResistance [CADOPS, FEEDERALL] -> get from
CIRCUITSOURCE
MaxPositiveSequenceReactance [CADOPS, FEEDERALL] → get from
CIRCUITSOURCE
NegativeSequenceReactance [CADOPS, FEEDERALL] → get from CIRCUITSOURCE
MaxZeroSequenceReasistance [CADOPS, FEEDERALL] → get from
CIRCUITSOURCE
MaxZeroSequenceImpedance [CADOPS, FEEDERALL] → get from
CIRCUITSOURCE
MaxKVar [CADOPS, FEEDERALL] → get from CIRCUITSOURCE
MinKVar [CADOPS, FEEDERALL] → get from CIRCUITSOURCE
EmgergencyCapacityKW [CADOPS, FEEDERALL] → get from CIRCUITSOURCE
VoltageAngle [CADOPS, FEEDERALL] → get from CIRCUITSOURCE

SupportStructure [CADOPS, FEEDERALL, NABACKWARD]
PrimaryReferencePoleNumber [CADOPS, FEEDERALL] → DISTRIBREFNUMBER
LongPadNumber [CADOPS, FEEDERALL] → DISTRIBREFNUMBER

TieBus [CADOPS, FEEDERALL]
SubtypeCd [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]

TransformerBank [CADOPS, FEEDERALL]
SubtypeCd [CADOPS, FEEDERALL]
LongPadNumber [CADOPS, FEEDERALL] → PADNUM
GridCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
TransformerBankKVA [CADOPS, FEEDERALL]

TransformerUnitInstall [CADOPS, FEEDERALL]
PhaseDesignation [CADOPS, FEEDERALL]
KvaValue [CADOPS, FEEDERALL]

UgConductor [CADOPS, FEEDERALL]
SubtypeCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
MeasuredLength [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PrimaryOperatingVoltageValue [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
FeederAllPhase [CADOPS, FEEDERALL]
WireSizeCd [CADOPS, FEEDERALL]
WireMaterialCd [CADOPS, FEEDERALL]

UgConductorInfo [CADOPS, FEEDERALL]
ConductorSizeCd [CADOPS, FEEDERALL] → WIRESIZECD
ConductorMaterialCd [CADOPS, FEEDERALL] → WIREMATERIALCD
ConductorTypeCd [CADOPS, FEEDERALL] → WIRETYPECD

VoltageRegulator [CADOPS, FEEDERALL]
GridCd [CADOPS, FEEDERALL]
LoaNumber [CADOPS, FEEDERALL]
FeederId [CADOPS, FEEDERALL]
PhaseDesignationCd [CADOPS, FEEDERALL]
RegulatorAmpRating [CADOPS, FEEDERALL] ->
VOLTAGEREGULATORAMPRATING

VoltageRegulatorBank [CADOPS, FEEDERALL, NABACKWARD]
BankKvaValue [CADOPS, FEEDERALL]

To accomplish this configuration, each feature/object class is selected in ArcCatalog, followed by the selection of "ArcFM Properties Manager". Navigate to the Model Names tab of the ArcFM Properties Manager shown in Figure 3.3-5. From this tab, the "Network Adapter Object Class Model Name" under the Model Name Domain field is selected. Then the available Model Names for "CADOPS" and "FeederAll" are transferred across into the selected Model Names list box as shown in Figure 3.3-5.
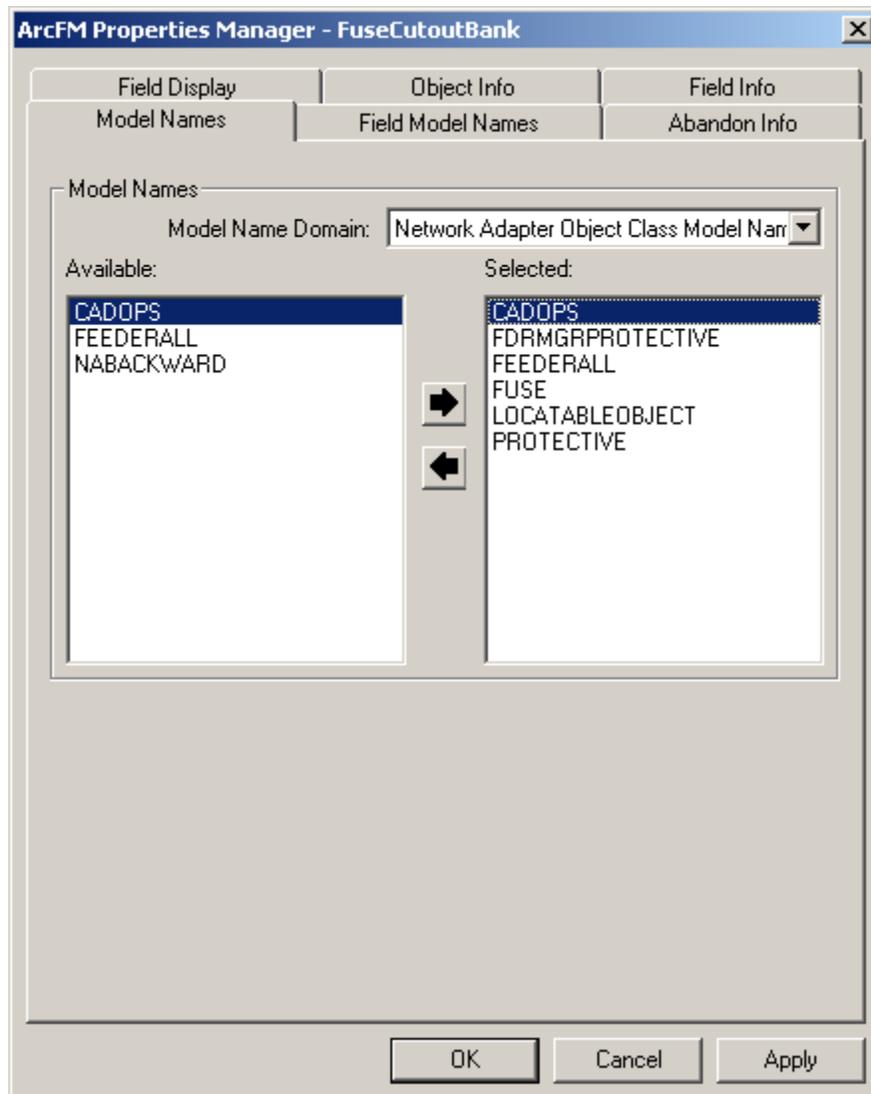
Figure 3.3-5.

Next, navigate to the Field Model Names tab. The above process is repeated for each field that is required for the ABB export. See Figure 3.3-6 for example:
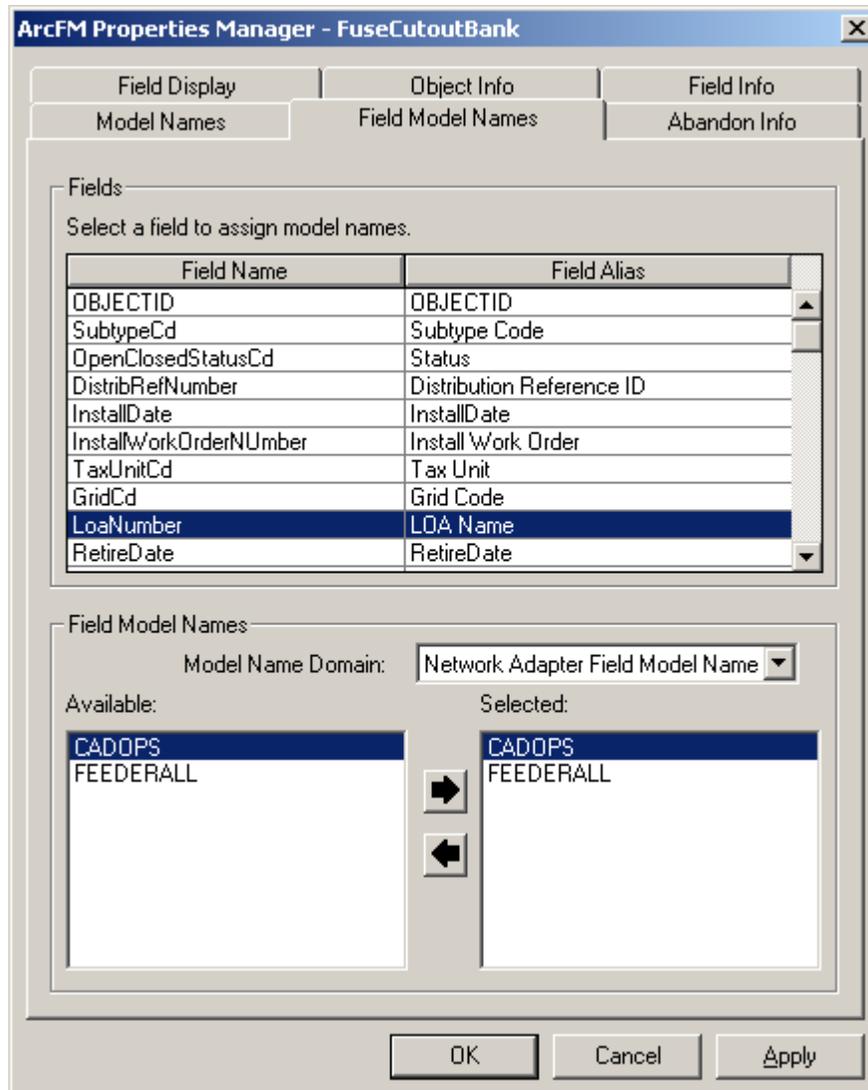
Figure 3.3-6.

Once these steps have been completed for each feature and object class, the Network Adapter will be successfully configured via ArcCatalog.

3.3.5 Network Adapter Installation

This section describes the installation process for installing the custom Network Adapter functionality. The core Miner & Miner Network Adapter is required to be installed prior to running the custom AEDR installation.

To begin, the setup.exe is run to start the Network Adapter installation. See Figures 3.3-7 through 3.3-9.
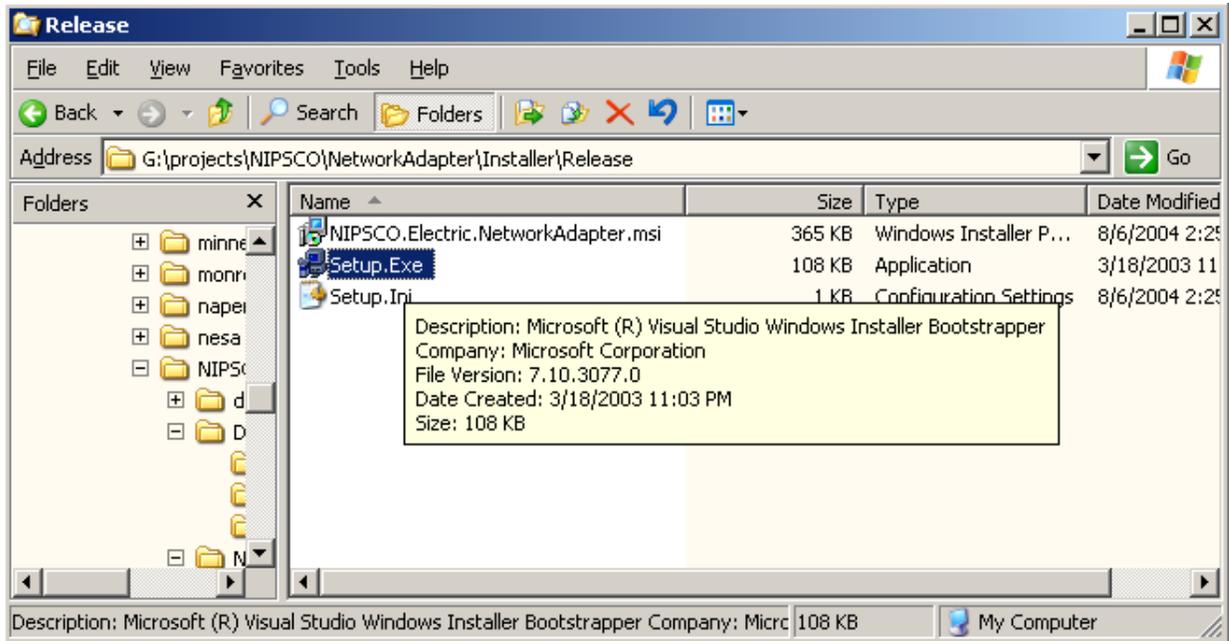
Figure 3.3-7.
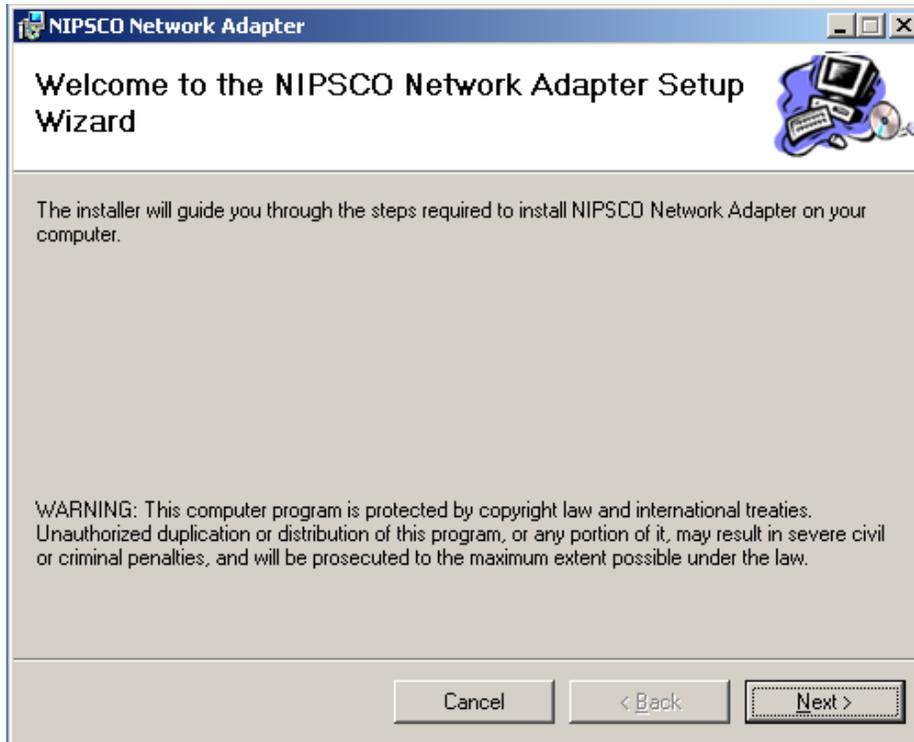
Figure 3.3-8.
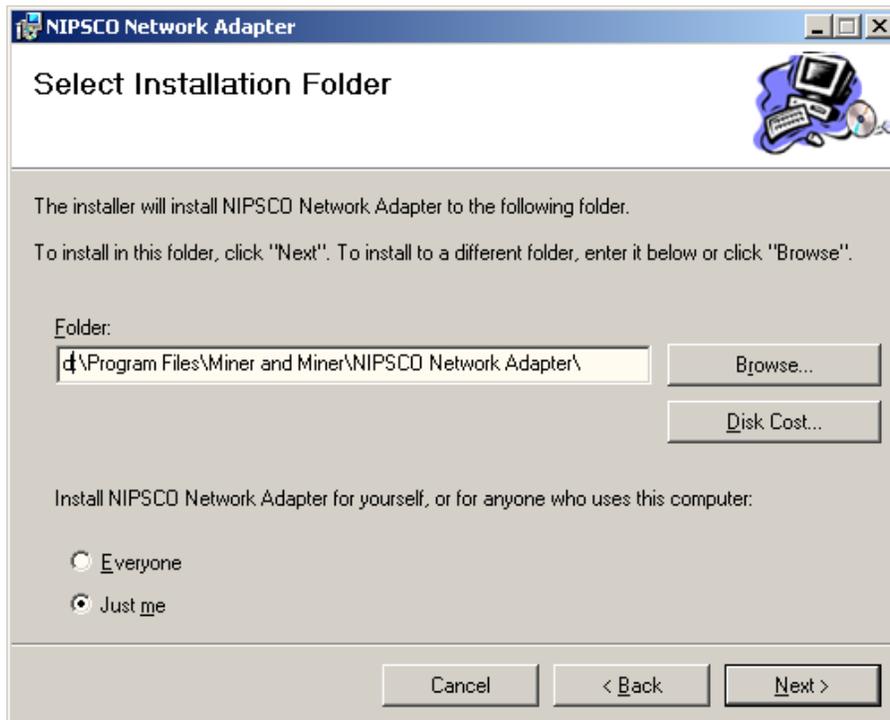
Figure 3.3-9.

After specifying the installation location, continue selecting "Next" until the installation is complete. At this point, the installation of the custom Network Adapter is complete and should be ready for use when the next ArcGIS/ArcFM session is started.

3.3.6 ArcFM/ArcMap Network Adapter Configuration

This section describes the configuration of the options that are available from within ArcMap. These options should be reviewed and/or configured before running the export on any given machine. The selected values are saved to the system registry to persist the user's choices between ArcMap sessions. The options screen shown in Figure 3.3-10 has the following format:
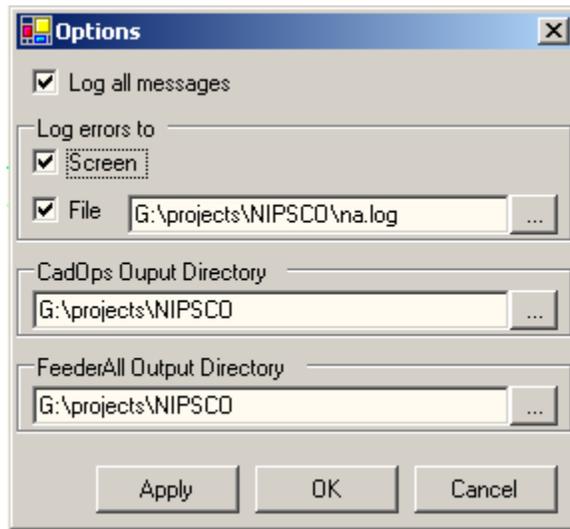
Figure 3.3-10.

3.3.6.1 Log All Messages

The 'Log all messages' checkbox shown in Figure 3.3-10 allows the user to save all of the errors and warnings to a log if it is checked. This log can be to the screen and/or to a file as determined in the next section. If this checkbox is left unchecked, only the errors will be saved to the log, any warnings or other informative messages will be discarded.

3.3.6.2 Log Errors to…

The "Log Errors To" section shown in Figure 3.3-10 determines where the log (including errors and/or warnings) will be recorded. Checking the 'Log errors to Screen' checkbox will pop up a logging window when an export is started. As warnings or errors are encountered, they will be displayed in the logging window in a real-time fashion.

Checking the "Log Errors To File" checkbox will save log information to a file specified in the textbox besides the checkbox. The user can click the "…" button next to the text box to browse the file system to select a location for the log. This log file will be overwritten each time the export is run so if the log files need to be retained, the user should copy it to another location or change the file name of the saved file.

3.3.6.3 CADOPS Output Directory

The 'CADOps Output Directory' shown in Figure 3.3-10 specifies the location where to save the CADOps export files. The user can click the "…" (Browse) button next to the text box to browse the file system to select a location for the files.

3.3.6.4 FeederAll Output Directory

The 'FeederAll Output Directory' shown in Figure 3.3-10 specifies the location where to save the FeederAll export files. The user can click the "…" (Browse) button next to the text box to browse the file system to select a location for the files.

3.3.7 XSL Transformation

This section describes the various XSL and XML files that are used as part of the custom Network Adapter implementation. These files are used to configure and map the transformation of the core Network Adapter XML export into the comma separated value (CSV) files that are required for the CADOPS and FeederAll systems. There are thirteen XSL files and one XML file all of which can be viewed in Internet Explorer and edited with any text editor including Notepad. The files are each described in detail below.

3.3.7.1 ConductorRank.xml

This file defines the distinct conductor size and material combinations and their relative size in increasing order. Items can be added and removed from the list as needed. The transformation uses this file to ensure that when there are multiple conductors of varying sizes associated to a single line (such as three phase primary overhead lines) that the smallest sized conductor is passed into the ABB systems. This is required by FeederAll to allow it to run its algorithms based on the lowest common size factor of a line.

3.3.7.2 CADOps.xml

This file is responsible for calling the appropriate XSL code templates for outputting the files needed for CADOPS. For each CADOPS CSV file (device, source, node, etc), there are sections within the CADOps.xsl that define the appropriate templates to be called for the different feature classes that need to be included in each CSV.

3.3.7.3 FeederAll.xml

This file is responsible for calling the appropriate XSL code templates for outputting the files needed for FeederAll. For each FeederAll CSV file (device, source, node, etc), there are sections within the FeederAll.xsl that define the appropriate templates to be called for the different feature classes that need to be included in each CSV.

3.3.7.4 Common.xml

This file defines common reusable templates that can be called from within any of the XSL stylesheets. If any given template is shared across several XSL files, it should be included here.

3.3.7.5 ABBLookups.xml

This file contains common lookup values for determining an ABB Device Category, Voltage Level, Device Type, or Line Type based on distinct key values. The original creation of this file was based on the old type files used within the legacy system as well as their related tables within the ABB databases. As new categories, voltage levels, device types, or line types are added or deleted from the NIPSCO equipment inventory, these tables can be updated to account for the additions or deletions. As long as the additions maintain the same format, the transformation will seamlessly integrate the new lookup values into the process.

3.3.7.6 Capacitor.xml

This file contains all of the templates used for outputting the Capacitor features into the capacitor CSV (.CAP) file format. Any updates to the formatting or fields exported for capacitors should be made in this file.

3.3.7.7 Device.xml

This file contains all of the templates used for outputting the general device features into the device CSV (.DEV) file format. These devices currently include switches, fuse cutout banks, recloser banks, sectionalizer banks, voltage regulators, primary open points, FeederAll open points, customer generators, and substation breakers though not all of these devices are included for both the CADOPS and FeederAll exports (reference the CADOps.xsl and FeederAll.xsl files to determine which devices are exported for each application). Any updates to the formatting or fields exported for any of the above-mentioned devices should be made in this file.

3.3.7.8 Line.xml

This file contains all of the templates used for outputting the overhead and underground conductor, bus bar, and tie wire features into the line CSV (.LIN) file format. The overhead and underground conductor will include both transmission and distribution features if they are selected for the export. Any updates to the formatting or fields exported for any of the above-mentioned line feature classes should be made in this file.

3.3.7.9 Load.xml

This file contains all of the templates used for outputting the transformer bank and meter features into the load CSV (.LDE) file format. Any updates to the formatting or fields

exported for either the transformer bank or meter feature classes should be made in this file.

3.3.7.10   Mpoint.xml

This file contains all of the templates used for outputting the meter points into the meter point CSV (.MPT) file format. Currently, meter points are only exported for FeederAll and are created at the location of substation breakers. Any updates to the formatting or fields exported for meter points should be made in this file.

3.3.7.11   Node.xml

This file contains all of the templates used for outputting the node points into the node CSV (.NDE) file format. Nodes (along with paths, mentioned in the next section) provide the x and y coordinates of all of the export files. Nodes are created at the end points (from-point and to-point) of each line. Any updates to the formatting or fields exported for nodes should be made in this file.

3.3.7.12   Path.xml

This file contains all of the templates used for outputting the path points into the path CSV (.PTH) file format. Paths (along with nodes, mentioned in the previous section) provide the x and y coordinates of all of the export files. Paths are created at any vertices within a line (between two nodes) as well as at any network junctions. Any updates to the formatting or fields exported for paths should be made in this file.

3.3.7.13   Source.xml

This file contains all of the templates used for outputting the any source features into the source CSV (.SRC) file format. These sources currently include power transformers, substation breakers, and customer generators though not all of these devices are included for both the CADOPS and FeederAll exports (reference the CadOps.xsl and FeederAll.xsl files to determine which sources are exported for each application). Any updates to the formatting or fields exported for any of the above-mentioned sources should be made in this file.

4 ArcView

4.1 Overview

ArcView / ArcFM Viewer is an ArcGIS Desktop extension providing users with the ability to analyze and understand geographic data and their relationships, create maps and data and generate reports. ArcView allows viewing and editing of data, the extent to which is governed by security profiles.

ArcView / ArcFM Viewer was identified as the toolset to distribute to users who needed full in-depth access to the GIS and asset management data contained in the AEDR system. Although we began with identifying ninety-five occasional users, there are now one hundred sixty-seven (and growing) users of ArcView from various departments throughout NIPSCO.

The work involved in implementing ArcView was mostly related to setting up licensing, security and training the users. This section describes the training effort.

4.2 ArcView Training

Because these tools needed to be rolled out to a large number of users in a very short timeframe, a custom, compressed four hour training course was designed to give the users an overview of the key ESRI and Miner & Miner tools that they would need to do their jobs. The consumers of the ArcView / ArcFM Viewer application were divided into four groups:

- Facility Locate Screening ~ 5 users
- Electric Distribution Systems Resource Management ~ 10 users
- Scheduling & Assigning Center ~ 10 users
- Engineering ~ 70 users

The course was scheduled several times throughout Q3 and Q4 of 2006 to provide ample opportunity for the users to attend. The content of the course is described in the sections below.

4.2.1 Getting to Know the AEDR System

This section of the course provided an overview of the six major components of the AEDR implementation including:
- AEDR Online Help
- SAGE (Standalone Geodatabase Editing)
- Facility Browser
- Field Browser
- GIS – ArcEditor
- GIS – ArcView

The main concept of this section was to show that the AEDR system runs off of a single set of system databases but that there are several different portals into the data.

4.2.2 Navigating the ArcView Application

This section describes that AEDR ArcView is simply ArcMap with view-only licenses. It reviews the distribution of the application via Citrix and gives the users specific instructions on how to connect to the application. The basic components of the ArcMap window are also discussed with an emphasis on how ESRI technologies differ from the CAD-based technologies previously used at NIPSCO. The section then takes a look at the concept and use of ArcFM stored displays:

- What is a stored display
- How to access a stored display
- How to customize a stored display
- How to save a user stored display

The section concludes with a review of the standard AEDR navigation tools shown in Figure 4.2-1.
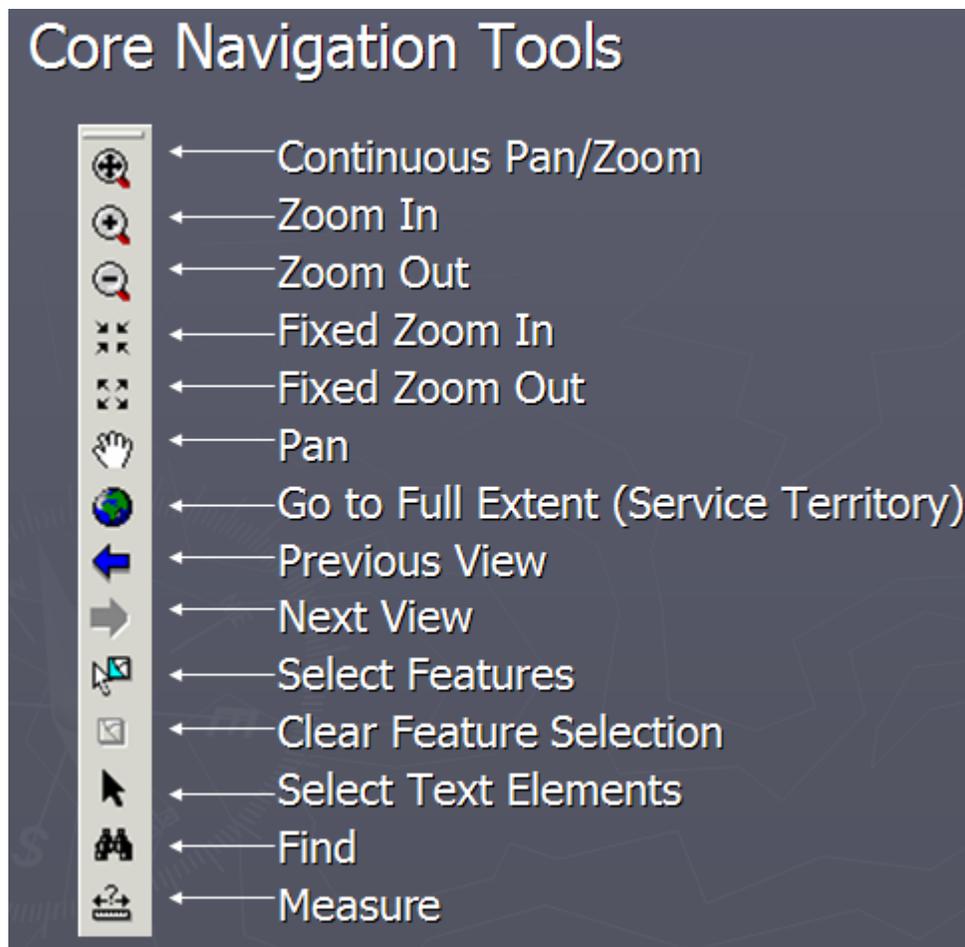
Figure 4.2-1.

4.2.3 Standard Tools

This section concentrated on the use of the ArcFM Attribute Locator and the ArcFM Attribute Viewer. The areas covered for each are listed below.

Attribute Locator
- Basic queries against features and tables
- Attribute Queries
- Feeder Manager Queries
- Query Options

Attribute Viewer
- Different ways to select features
- Selectable Layers
- Viewing records in the attribute viewer
- Traversing database / business relationships

4.2.4 Advanced Tools

The advanced tools section attempted to build on what the users had already learned. It contained information on three key areas. The users were not expected to necessarily retain all of the information in this section but it was intended to show them that these types of tasks could be accomplished in ArcView. The training materials were then made available to the users to reference in the future for use of these advanced tools when they were needed. The tools covered included:

- Select By Location: Use of ESRI's select by location tools to be able to select a set of features based on their spatial relationship to other features.
- Tracing Tools: This area concentrated on the use of the ArcFM electric traces:
    - Distribution Trace
    - Upstream Trace
    - Downstream Trace
    - Upstream Protective Device Trace
    - Downstream Protective Device Trace
- Reporting: Use of ESRI's basic out-of-the-box reporting tools to generate simple reports based on a selected set of features.

A complete set of the training presentation is included later in this section.

4.2.5 Usage

ArcView is used extensively by various types of engineers and within the Service Request process which is described in the Customizations section (Section 2) in this report. Engineering, Records, Damage Prevention, Gas Integration Center, Electric Distribution Systems Resource Management and the Rate Department all have been trained and receive the benefits from using ArcView.

As new engineers, record clerks, etc. are hired, periodic and various flavors of ArcView training sessions are held. The training sessions currently developed are ArcView Basic, ArcView for Fast Path Engineers and ArcView for Record Clerks.

Consistent with all AEDR components, ArcView Help has been established in the AEDR Online Help System. See Figure 4.2-2.
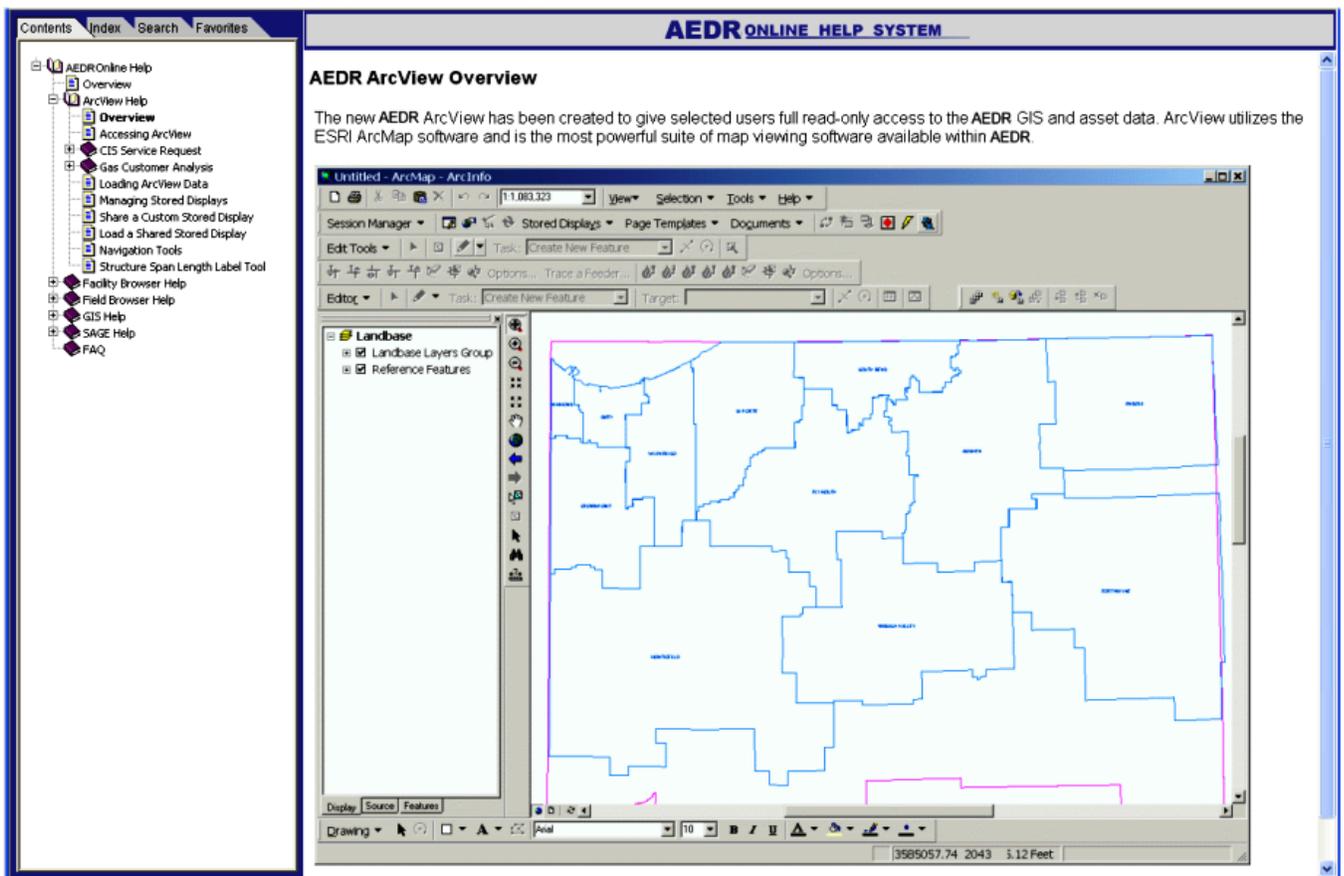
Figure 4.2-2.

Appendix G contains the MS Power Point presentation that served as the lecture medium.

The ArcView implementation and training was governed by the AEDR Deployment Phase II Project Plan located in Appendix A.

5 CAD Export Part 2

5.1 Overview

A requirement to provide a new landbase for the ABB CADOPS interface was established within a few months of the initial AEDR implementation. The ABB interface requirement to produce very small files (.4-3.5MB), were easily produced in the legacy AutoCAD environment. However, the non-productized CAD Converter tool, while useful for producing larger AutoCAD DWG and DXF files from the AEDR were unable to handle the small file size required for the interface. A supplementary tool, Ptarmigan CAD Converter, was purchased to create the landbase for ABB. Ptarmigan CAD Converter is a conversion tool that exports GIS data from the NIPSCO Geodatabase to AutoCAD 2000 DWG and DXF files.

The aforementioned non-productized CAD Converter tool is described in detail in the Validation Integration – Results of Immediate Architecture Implementation report. The implementation of the new supplementary tool, Ptarmigan CAD Converter, is described in this report.

Although both CAD Converter tools provide similar functionality, both will continue to be utilized based on different functional business requirements.

NIPSCO's Third Party Request and LOA CAD Export processes are performed using Ptarmigan CAD Converter. The Operational Instructions have been provided for both processes to show examples of the manner in which Ptarmigan CAD Converter is used for various applications at NIPSCO.

The Ptarmigan CAD Converter offers the following features:
- It runs on ArcGIS 9.2.
- It exports graphics and labels/annotation.
- It exports to an AutoCAD DWG and DXF formats (presently to an AutoCAD 2000 format).
- It allows the user to specify a geographic area or input grid layer, and the layers to be exported.
- It provides clean clipping of GIS data to the user-defined export boundaries.
- It offers increased efficiency in terms of file size of the output CAD files, producing complete and accurate files at a fraction of the size of other CAD Converter applications.

5.2 Functional Description

Ptarmigan CAD Converter allows users to translate geographic features from ArcGIS / ArcFM formats to DWG, allowing data to be viewed in Autodesk applications, such as AutoCAD and AutoCAD Map.
Ptarmigan CAD Converter offers a simple and comprehensive user-interface, employing several methods to export features to a chosen export file from existing CAD drawing

templates. The tool allows exporting features based on 2 selection types: features that lie within a polygon graphic or features that lie within a specific grid layer. Ptarmigan CAD Converter requires the GIS features to be mapped to the associated CAD layer via a Microsoft Access file. Ptarmigan CAD Converter supports AutoCAD blocks.

5.3 Operational Use

Option 1: Export by selected graphic
In order to use the select by graphic capability of the Ptarmigan CAD Converter, the desired location is zoomed to and a polygon is drawn using ArcMap drawing tools. The graphic is selected as shown in Figure 5.3-1. Next, the Ptarmigan CAD Converter is launched.
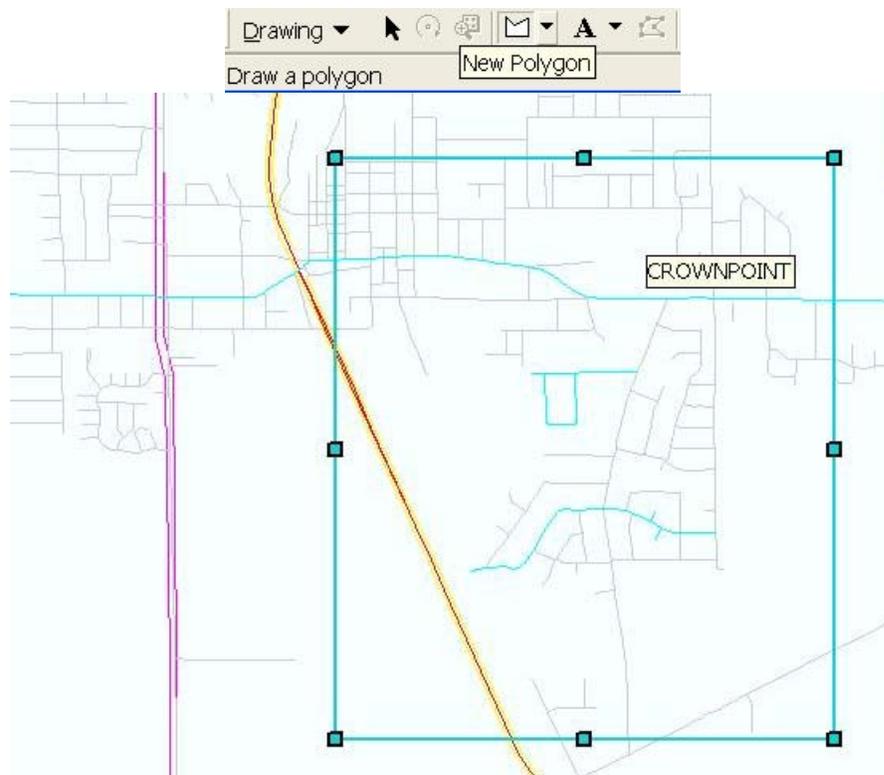
Figure 5.3-1.

Clicking the NI Export to CAD V2 command on the Ptarmigan CAD Converter toolbar as shown in Figure 5.3-2 launches Ptarmigan CAD Converter.

Figure 5.3-2.

The Ptarmigan CAD Converter screen (Figure 5.3-3) allows the user to choose the feature selection type (by graphic or by grid layer), designate an output file, choose the setup parameters, and reference an AutoCAD template drawing.
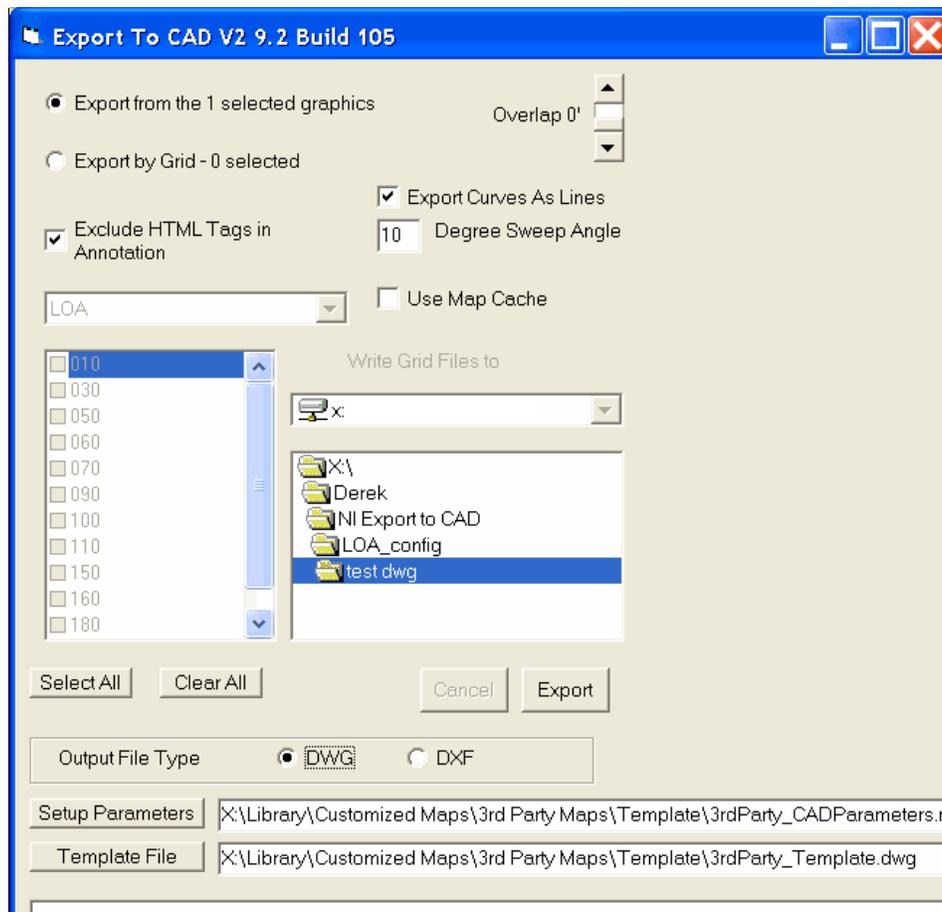
Figure 5.3-3.

1. In Figure 5.3-3, the radio button for Export from the one selected graphic is chosen. (Exporting by selected graphic allows the user to export based on the extent of a polygon drawn to the user's specification.)

2. For Output File Type, either the 'DWG' or 'DWF' radio button is chosen depending on the desired output format.

3. For Setup Parameters, The desired CAD Parameters input file is navigated.

4. For Template File, The desired CAD Template file is navigated.

5. Clicking Export, a save location is chosen and drawing name is assigned.

6. The Ptarmigan CAD Converter will process all GIS data to the specifications of the Setup Parameters file and export them to a new CAD file based on the

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Template file. A progress window is displayed while the export processes the data, and a notification will appear when the export is complete.

Option 2: Export by Grid feature
Clicking the NI Export to CAD V2 command on the Ptarmigan CAD Converter toolbar launches the Ptarmigan CAD Converter.

Figure 5.3-4.

1. In the Figure 5.3-5, the radio button for Export by Grid is chosen.
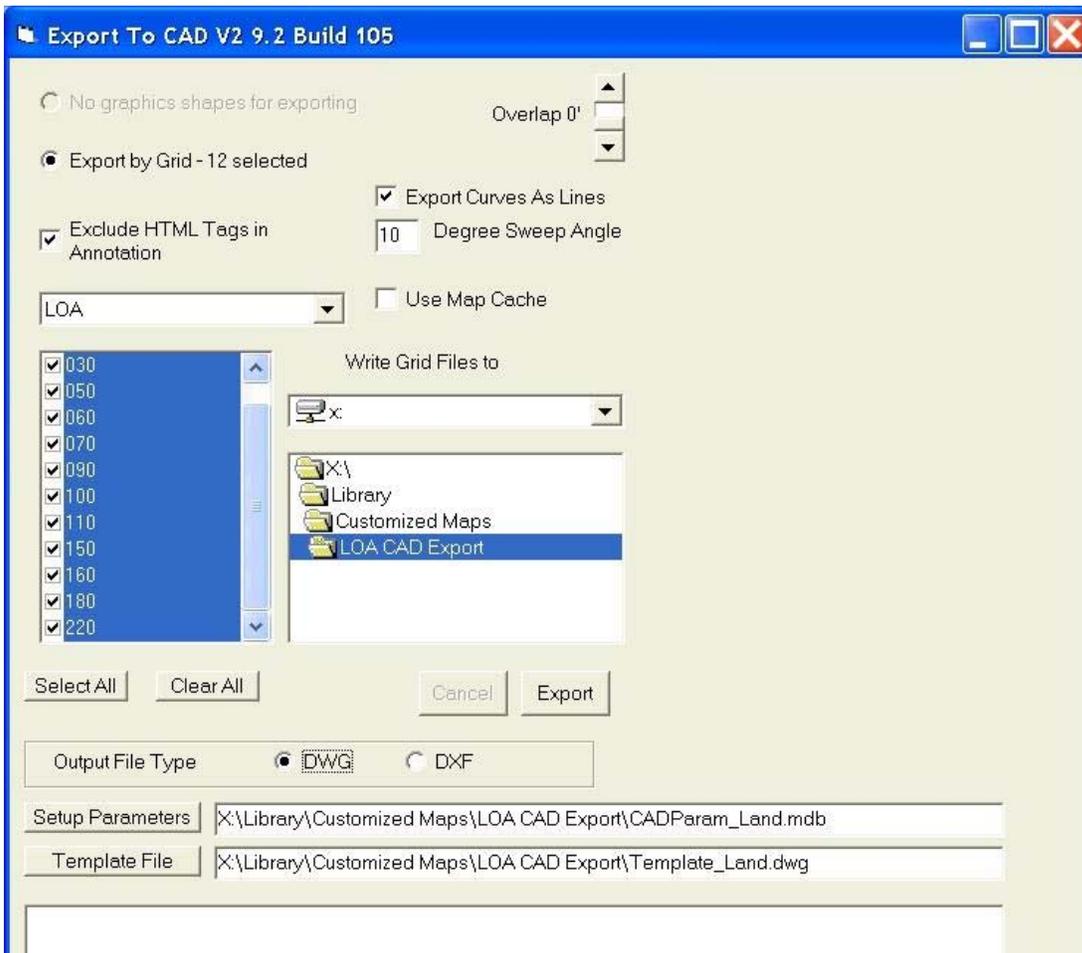
Figure 5.3-5.

2. The dropdown list is used to select the desired grid layer. The desired layer must already be part of the current ArcMap file. Then, in the box below the dropdown list, the desired grids to export or 'Select All' is clicked.

3. Under Write Grid Files To, the desired location is navigated to save the files. Ptarmigan CAD Converter will automatically save each output file with the name of the grid layer in the folder specified.

4. For Output File Type, the radio button for either 'DWG' or 'DWF' is chosen depending on the desired output format.

5. For Setup Parameters, the desired CAD Parameters input file is navigated.

6. For Template File, the desired CAD Template file is navigated.

7. Clicking Export, the Ptarmigan CAD Converter processes all GIS data to the specifications of the Setup Parameters file and exports them to a new CAD file based on the Template file. A progress window is displayed while the export processes the data, and a notification will appear when the export is complete.

Creating the CAD Parameters setup file

The Ptarmigan CAD Converter requires a parameters file which defines how the GIS data is mapped to the CAD output format. The parameters file shown in Table 5.3-1 can be created in a Microsoft Access database (.mdb) file.

Table 5.3-1.

ArcGISFeatureClass	Name of the input GIS layer
QueryDef	(Optional) A query that filters the output data on an attribute field value.
DWGLayer	Name of the output CAD layer
DWGColor	Color for the CAD output
DWGStyle	Linestyle for the CAD output
DWGWeight	Lineweight for the CAD output
DWGFontID	Text style for the CAD output
DWGJustification	Text justification for the CAD output
DWGTextSize	Text size for the CAD output
DWGTextString	Text string for the CAD output

DWGTextOffset	Text offset for the CAD output
DWGRotationField	Rotation for the CAD output
DWGCellName	CAD block name to be inserted
DWGCellSize	CAD block size
DWGCellRotation	CAD block rotation value

CAD Parameter files can be created and stored for any number of Ptarmigan CAD Converter output procedures. Once created, they can be easily updated to implement changes in the output CAD files.

5.4 Assumptions

The files created by Ptarmigan CAD Converter will comply with the AutoCad 2000 DXF specification. Because of known limitations in ArcMap, the DXF files may not render properly inside of ArcMap.

5.5 Examples of Ptarmigan CAD Converter Usage

5.5.1 Third Party Requests

5.5.1.1 Overview

The GIS department regularly receives map requests from outside companies. These maps are mainly used for development projects in the survey and planning stage. It is always explained to the customer that they will receive a DWF (Web format view) of the area in question via e-mail. We restrict the files we provide to a DWF format instead of a DWG. Primarily this is done to prevent the user from copying this data directly onto their construction prints. As a result of the landbase data being specific to NIPSCO, any use of it in DWG format copied onto a customer's construction drawing could lead to potential errors and misinterpretations. The customer is advised that the information is to be used for planning purposes only and is not to replace the need to call for facility locates prior to any construction. It is also explained to the customer that all facilities shown on the map views are approximate locations only.

5.5.1.2 Operational Instructions

The Third Party request process operating instructions using Ptarmigan Cad Converter are described below:

5.5.1.2.1 Receiving the Requests

The GIS department receives map requests via a Third Party Request Line, the requestors are asked to send a fax with the following information:

- Cover sheet with their company name
- Name and email address
- Description of area requesting
- Brief reason for request
- Signature

5.5.1.2.2 Using ArcMap and Ptarmigan CAD Converter

Map requests require the use of Ptarmigan Cad Converter in order to convert the data from GIS to CAD DWF file format. The DWF is a secure (un-editable) format by Autodesk, similar to a .PDF. The freeware applications DWF Viewer or Volo Viewer are used to open DWF's and are both available at www.autodesk.com.

Steps to Create the DWF:

1. Open the X:\Library\Customized Maps\3rd Party Maps\Template\3rdParty_Template.mxd file in ArcMap.

2. Zoom to the requested area. Draw a shape graphic to define the limits of the data to be exported as shown in Figure 5.5-1.

Figure 5.5-1.

3. Click on the "NI Export to CAD V2" toolbar button. If the NI Export to CAD V2 button is not available when ArcMap is started up, then it will need to be added to a toolbar. Follow these steps to add the NI Export CAD V2 button to a toolbar.
   a. Click Tools > Customize
   b. Click the "Commands" tab

c. In the list, scroll down and click on AEDR

d. Drag the "NI Export to CAD V2" command to any existing toolbar or
create a new "Ptarmigan CAD Converter" toolbar.

Figure 5.5-2.

Refer to Figure 5.3-5 for the remaining steps:

4. Choose the radio button for Export from the 1 selected graphics.

5. For Output File Type, choose the radio button for "DWG".

6. For Setup Parameters, navigate to X:\Library\Customized Maps\3rd Party
Maps\Template \3rdParty_CADParameters.mdb.

7. For Template File, navigate to X:\Library\Customized Maps\3rd Party
Maps\Template \3rdParty_Template.dwg.

8. Click Export. Choose a save location and assign the drawing a name in the
format: Company_RequestorsLastName_MM_DD_YY.dwg.

9. The application will process the export and create a file in the location specified.

10. When the export is finished, a message box will appear. Click OK.

11. The MS Access file may then be saved with a different name for future reference.
Close ArcMap.

12. See the next section "Finalizing in Autodesk Map".

5.5.1.2.3 Finalizing in Autodesk Map

1. Launch the new DWG in Autodesk Map.

2. Zoom to full extent by entering *Zoom* and then *e* on the command line. In order to cleanup the symbology and create a border (or "neatline") around the map, draw a box around the desired area using the *Rectangle* drawing tool on the toolbar as shown in Figure 5.5-3.
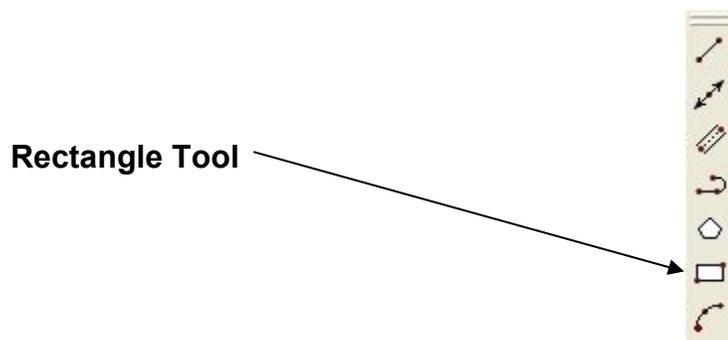
Rectangle Tool

Figure 5.5-3.

3. Find the *Boundary Trim* function on the menu bar at Map/Tools/Boundary Trim.

4. Click *Select Boundary* and select the rectangle previously created. The rest should be set up as shown in Figure 5.5-4.
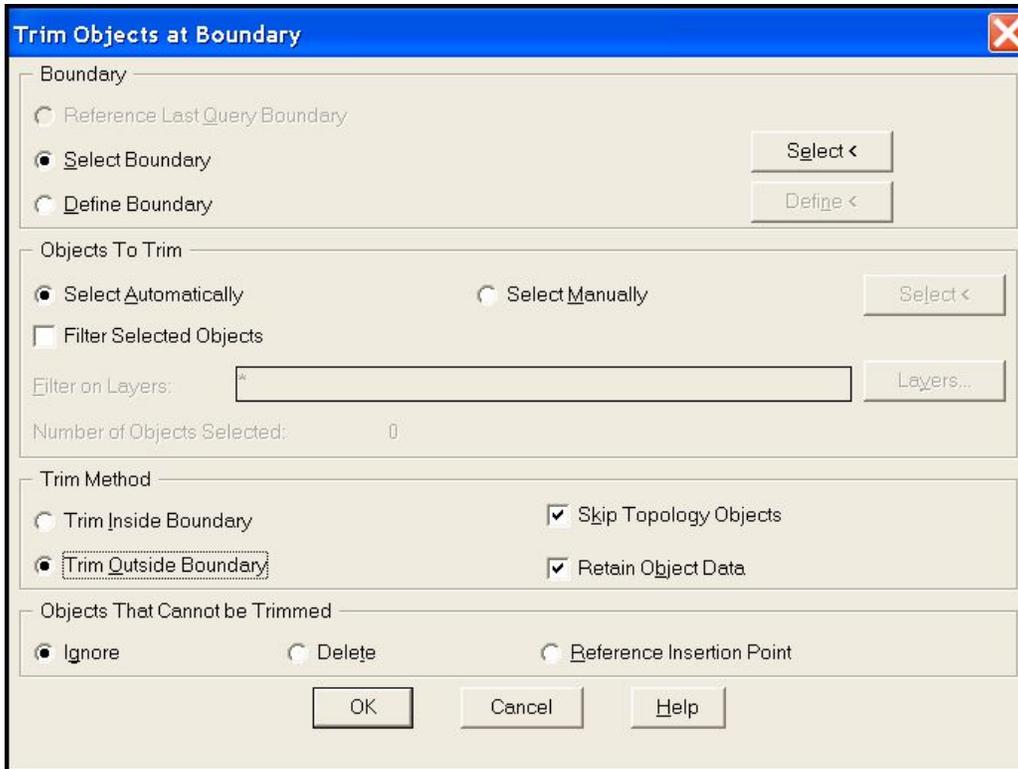
Figure 5.5-4.

5. Insert the Legend and Scale by going to the *Insert/Block* menu and finding the Legend layer in the *Name* drop down box at the top.

6. Verify the *Explode* box is checked on the lower left corner and click OK. Click the position of the Legend and Scale. The result should appear as in Figure 5.5-5.

Figure 5.5-5.

7. Double click the disclosure note in the Legend block and insert the company name. Send the text to the back by selecting it and going to Tools/Display Order/Send to Back.

8. Convert the drawing to the DWF file format by going to File/Plot and selecting the DWF Classic (R14look).pc3 plotter configuration. In the Plot Setting tab, select "Scaled to Fit for the Plot Scale". Click OK to plot.

5.5.2 LOA CAD Exports and Ptarmigan CAD Converter

5.5.2.1 Overview

NIPSCO engineers require up-to-date CAD files showing Electric, Gas and Landbase features. To meet their needs, we provide two updates per month of these CAD files and place them on a shared network drive.

5.5.2.2 Operational Instructions

The LOA CAD Export process operating instructions using Ptarmigan CAD Converter provide current data from the AEDR GIS system in CAD format. The following steps will detail this process.

A separate file will be created for each LOA for Landbase, Electric and Gas.

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5.5.2.2.1 Creating the Landbase CAD Files

1. Open the Landbase.mxd file in ArcMap.

2. Click on the "NI Export to CAD V2" toolbar button shown in Figure 5.5-6.

Figure 5.5-6.

3. In the Export to CAD V2 9.2 Build 105 dialog box shown in Figure 5.5-7, choose the radio button for Export by Grid.
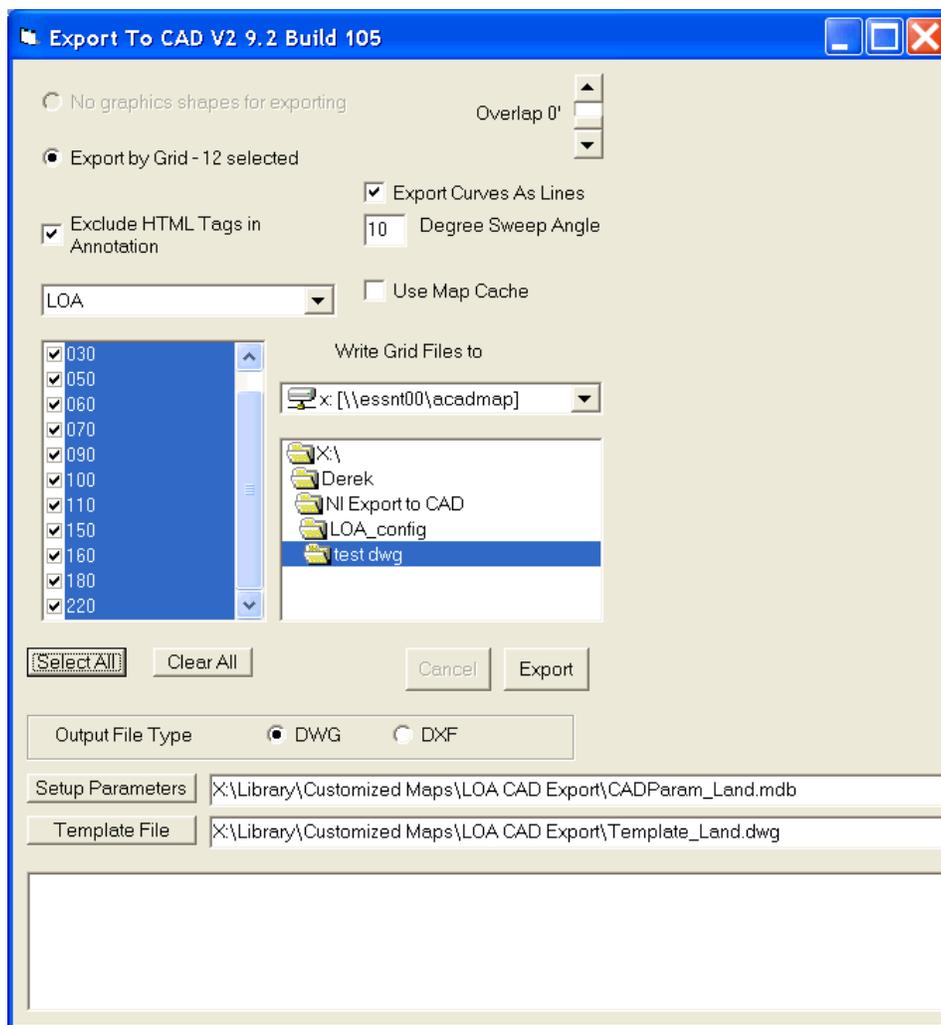
Figure 5.5-7.

4. Below that, verify the dropdown list is set to "LOA". The application will process the LOA grids. In the list below "LOA", click "Select All" to verify they are all selected.

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5. For Output File Type, choose the radio button for "DWG".

6. For Setup Parameters, navigate to the CAD Param_Land.mdb.

7. For Template File, navigate to Template_Land.dwg.

8. Under *Write Grid Files To*, navigate to the Customized Maps library, LOA CAD Export Land file.

9. Click Export. The application will begin processing and will create a CAD file for each LOA.

10. When the export is finished, a message box will appear. Click OK.

11. Close ArcMap.

12. Follow the same procedures for Electric and Gas.

6 Map Production

6.1 Overview

NIPSCO has implemented a wide variety of tools to convey spatial locations and facilitate spatial analysis of NIPSCO's facilities. Map Production is one of the tools that play an important part in the overall AEDR experience. Many users can generate their own simple maps however complex maps involving queries to the database, etc. are generated for the users by the GIS project team. NIPSCO has developed a library of complex, repeatable map processes. The Pole Inspection program is one example of the more complex mapping and data updating processes performed by the GIS project team.

This document describes the instructions to generate a series of maps detailing polygons within each LOA which contain wood poles to be inspected for the annual Pole Inspection Program. The methods behind this process were updated, from AutoCAD and an Access Database, to fit within the framework of AEDR. Many standard tools within ArcGIS were utilized as well as the GRID and Map Book functionality available through ArcFM. The goal of this document is to lay out the steps that must be taken each year to generate, document, and print the pole inspection maps and then subsequently load the inspection results back into the AEDR.

OBJECTIVES:

Create data and functionality within AEDR to satisfy the needs dictated by the Pole Inspection Program via Electric Standards Department personnel:

- Complete the Wood Pole Inspection and Treatment Program cycle by updating AEDR with the previous years' pole inspection data.

- Create a set of polygons within each LOA that contain a number of wood poles for inspection as close as possible to the budgeted amount of wood poles that need to be inspected for that particular LOA (as provided by the Electric Standard Department).

- Create a reusable and efficient process within AEDR that will allow the pole inspection work to be automated as much as possible.

BACKGROUND/HISTORY

The Wood Pole Inspection and Treatment Program is a process used to evaluate the condition of each wood pole and to extend the service life through supplemental preservative treatment. This applies to all wood pole structures currently in use in all of the nine LOAs of NIPSCO territory.

The legacy process consisted of manually selecting GRID cells, calculating the total value of wood poles, and visually selecting GRID cells that add up to a given value of budgeted poles for each LOA. The main tool used for this work was AutoCAD.

6.2 Master Grid Creation

The initial inspection GRID was created in AutoCAD. The size of the grid was largely determined by viewing preferences of the final maps—based on size and scale in the D plotting size. This GRID was presented to the GIS Department as a DWG file. Each LOA had its own arbitrary GRID associated with it, which created overlap between the LOAs. The GRID was not a completed entity across every LOA in their respective entirety. It was necessary to manually append cells to the extent of the GRID to fill in the areas where there was no LOA coverage.

Once the GRID was extended to completely cover each of the respective LOAs, it was loaded into an ArcGIS feature class within the production geodatabase – arcfm8.landbase.ArcFMMapGrid. This is a generic feature class that is configured to work with the M&M ArcFM Map Books to allow for printing the pole inspection maps en masse. The pole inspection grid features were assigned attributes to uniquely identify the type of grid, the LOA, and a unique ID for each grid feature based on an X-axis, Y-axis approach as shown in Table 6.2-1.

Table 6.2-1.

Attribute	Example	Description
MapGridName	PI-LOA	Indicates a pole inspection grid in an LOA
MapSheetName	150-9,7	150=a specific LOA, 9 grids across, 7 grids up
MiscData	57	Field to hold the number of wood poles that are within the boundaries of the grid (see section)

This identification allows users to easily locate the grids on the map (digital or paper) and/or via a query. Figure 6.2-1 shows an example of part of a master grid in an LOA:

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150-3,3	150-4,3	150-5,3	150-6,3	150-7,3	150-8,3
150-3,2	150-4,2	150-5,2	150-6,2	150-7,2	150-8,2
150-3,1	150-4,1	150-5,1	150-6,1	150-7,1	150-8,1

Figure 6.2-1.

6.3 Pole Inspection Tracking

To make it easier to track targeted and completed pole inspection polygons, another new feature class was added to the AEDR geodatabase – arcfm8.landbase.PoleInspectionGrid. While the ArcFMMapGrid feature class stores the entire grid (with coverage over each entire LOA), the PoleInspectionGrid only contains grid features where pole inspections have or will be taking place during the current year. This feature class can also be used with the ArcFM map book functionality which provides great flexibility for their creation. The definition of the PoleInspectionGrid class is as shown in Table 6.3-1.

Table 6.3-1.

Attribute	Example	Description
MapGridName	PI-LOA	Loaded from the master ArcFMMapGrid
MapSheetName	150-9,7	Loaded from the master ArcFMMapGrid
PoleCount	57	Loaded from the master ArcFMMapGrid
Year	2007	The year the grid was inspected
Status	Completed	Either Targeted or Completed
Comments	……	Some helpful comments about the grid

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When the pole inspection process is started each year, the master grid polygons for that year are chosen. Once the grid polygons have been chosen, PoleInspectionGrid features will be created for each with the Year equal to the current year and the Status equal to 'Targeted'. Then once the pole inspections have been completed in the field (per the Electric Standards Department), the status of the PoleInspectionGrid features will be updated from "Targeted" to "Completed". This infrastructure provides an easy way to track the pole inspection grids from conception to completion and also allows us to symbolize the grids based on both year and status within a stored display.

6.4 Pole Inspection Stored Display

An ArcFM stored display has been created to view the master pole inspection grid (ArcFMMapGrid), all past completed inspection grids (PoleInspectionGrid), and all targeted inspection grids (PoleInspectionGrid) for the current year. This stored display is named "Pole Inspection – Completed" and is available as a user stored display under the SDE user. This stored display looks similar to Figure 6.4-1.

Figure 6.4-1.

The yellow areas indicate where pole inspections have been completed as of 2006 and the blue areas show the 2007 pole inspections. The red grid shows the master pole inspection grid. Layers are added to the stored display each year to show that year's targeted and completed inspection grids.

6.5 Pole Count Calculation for Grid Tile

The next step in the process is to calculate the number of wood poles within each grid polygon that need to be inspected. This operation is automated via a simple script.

1. Download the following current year .bas file from SourceSafe.
2. Open ArcMap and add this .bas file to the modules within the Normal.mxt file.
3. Load the Pole Inspection – Completed stored display.
4. Create a version for editing the grids and switch into that version.
5. Start Editing.
6. Using the select tool, select any set (1 or more) of ArcFMMapGrid polygons that have not been inspected and are in the next logical location for inspection within each LOA. Basically pick up where the last inspection left off moving from top to bottom, left to right across the ArcFMMapGrid polygons as shown in Figure 6.5-1.
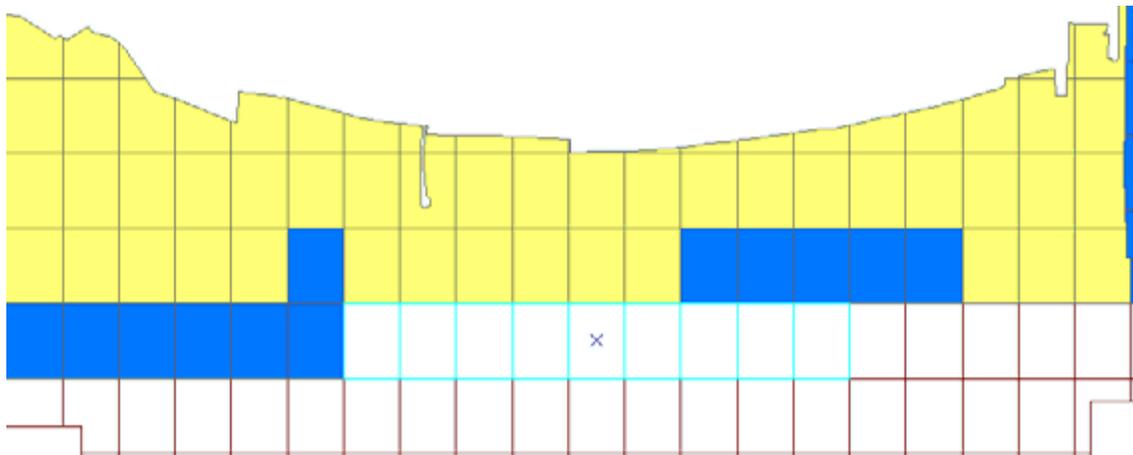
Figure 6.5-1.

7. Within the .bas file, run the GetPoleCountsForSelectedGrids method. This routine will set the MISCDATA field on each selected polygon equal to the number of qualifying wood poles for inspection within the polygon.
8. Turn on the labeling for the specific ArcFMMapGrid layer and verify the label field is set to the MISCDATA field. Figure 6.5-2 shows the totals for each selected polygon on the map:
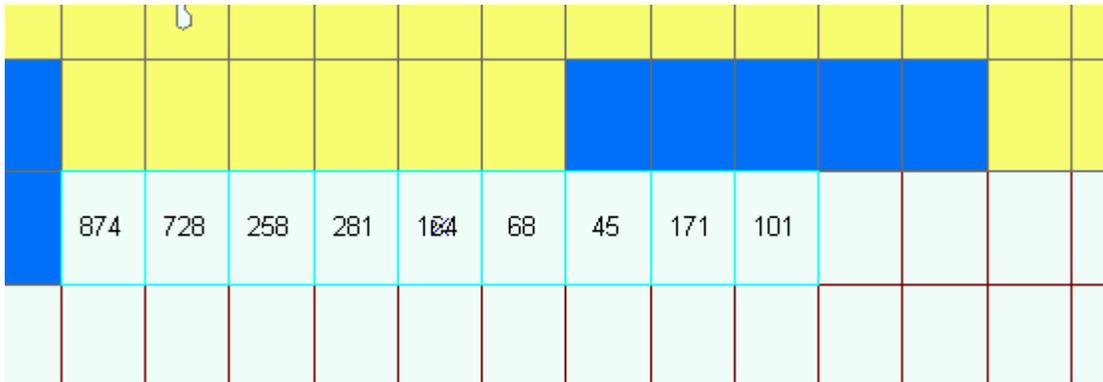
Figure 6.5-2.

9. Save the edits.
10. These pole counts will be used in the next section to determine how many polygons should be included in this year's inspection.

6.6 Grid Selection to Add up Designated Pole Totals for Each LOA

Each year at the beginning of the pole inspection program, the electric standards department decides on the total number of poles to be inspected as well as the breakdown of poles to be inspected in each LOA. They will provide this information to the GIS group in the form of a simple list. As an example, Figure 6.6-1 is the list provided for the 2008 inspections:

LOA	Poles to Inspect
Angola	2,265
Crown Point	2,718
Gary	4,227
Goshen	5,922
Hammond	3,308
LaPorte	3,504
Monticello	2,814
Plymouth	2,768
Valpo	2,474
Total	*30,000*

Figure 6.6-1.

Using the pole counts/grid generated in the previous section, add up the total poles for inspection going from top to bottom, left to right until a number that is as close as possible to the targeted number of poles is reached per the Electric Standards Department list. Depending on how many grids were selected in the previous section, additional grids

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may need to be selected and the steps in the previous section re-run to reach the targeted number of poles to be inspected.

This process can be semi-automated for LOA's with a large number of grid tiles. Select an approximate number of ArcFMMapGrid features (the first selection is usually just a guess). Within the modPoleInspection.bas script file, run the writeGridsAndCounts method. This will report back the selected sheet and grid name of each tile along with the count of the poles in each tile. At the bottom, the total (summed) number of poles in ALL selected grids will be shown. The selection set can be modified by adding additional grids or removing grids and then re-running the writeGridsAndCounts method until the desired count is achieved.

Once the desired number of grid cells has been determined for inclusion in this year's inspection, select only those grids on the map using the select tool shown in light blue in Figure 6.6-2.

Figure 6.6-2.

Using the modPoleInspection.bas file loaded in the previous section, locate the CreatePoleInspectionFeaturesFromGrid method and update the current year, the target field and add a meaningful comment such as "1st Batch 2008, created 2/08".

Start an edit session in a user version and run the CreatePoleInspectionFeaturesFromGrid method. This will create new PoleInspectionGrid features with the attributes set correctly as a targeted pole inspection for the current year. Save edits and refresh the map and the new PoleInspectionGrid features will be shown as in Figure 6.6-3.

Figure 6.6-3.

These steps will be completed for each LOA that will be included in the pole inspection. The selection set requires approval by the Electric Standards Department before the paper maps are generated so switch to layout view for each LOA and create a quick PDF for their review (use the steps in section 10 to generate these PDFs quickly). Send the PDFs back to the Standards Department before continuing. Reconcile and post edits when the Standards Department signs the approval form.

6.7 Paper Map Creation for Each Inspection Grid

Upon approval from the Electric Standards Department for the targeted pole inspection grids, a paper map will be created for each individual GRID cell that is selected for inspection within each LOA. These maps will contain the following information:

- GRID cell boundary
- Total number of poles in the GRID cell
- Poles
- Transformers
- Land parcels
- Pole numbers
- Streets
- Map ID: consists of the LOA the cell resides in and the arbitrary coordinate system values for reference.
- Directionals
- Standardized map features: north arrow, scale, date, etc.

Before individual maps are generated, all targeted pole inspection grid features will be updated with a pole count of 0 from "targeted" to "completed" using the modPoleInspection.bas script. Locate the UpdateCompletedGrids method and update the query line where the "Where clause" is defined. Change only the year value. Then start an edit session and run the method. This will update all targeted grids for the current year with a pole count of 0 to be completed. This will exclude them from further analysis.

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Next, the ArcFM Map Book tools will be used to generate the paper maps. This tool automates much of the manual work involved in creating paper maps. An ArcFM Stored Display and Page Template have been created specifically to be used with the ArcFM Map Books for the pole inspections:

- Stored Display: Pole Inspection
- Page Template: Pole Inspection 2007

Follow these steps to create a new map book for the pole inspections:
1. Load the Pole Inspection stored display.
2. Click the New Map Book button on the ArcFM Toolbar
3. Assign a name like "Pole Inspection 2008" as shown in Figure 6.7-1.
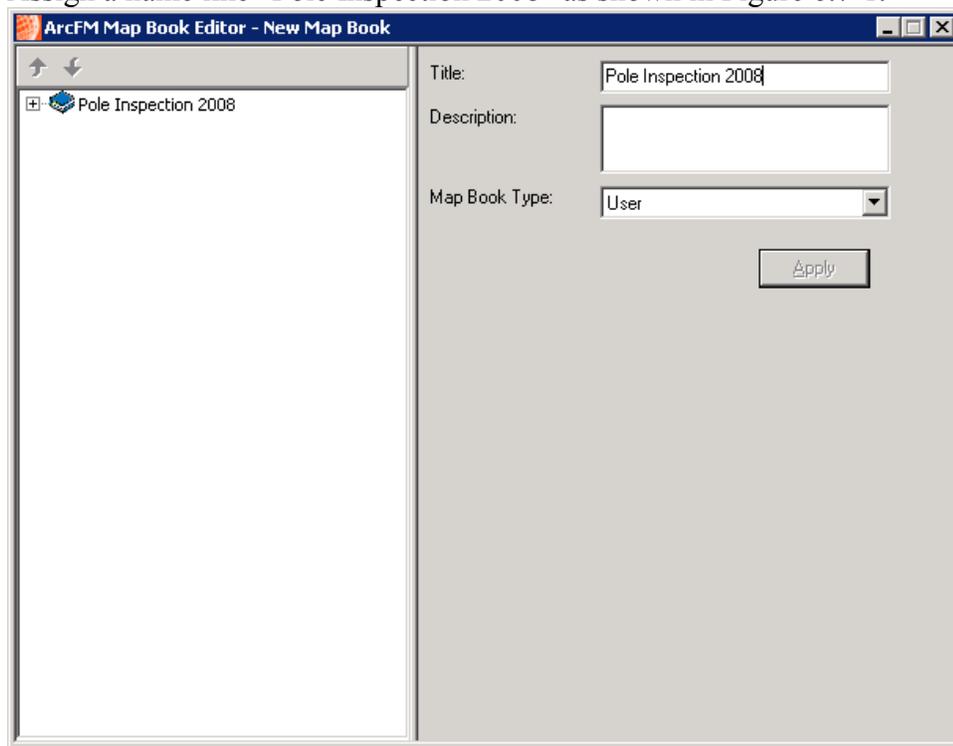
Figure 6.7-1.

4. For each LOA, right click the map book and choose Create Map Set. Name the map set with the LOA name.
5. Select each map set and on the Maps tab ensure that the layer = Pole Inspection Grid
6. Click the Locate button on the Maps tab to launch the ArcFM Locator.
7. As shown in Figure 6.7-2, Enter MapGridName=current LOA grid name (ex. PI-Gary), Year=current pole inspection year, and status=Targeted and then click Find.
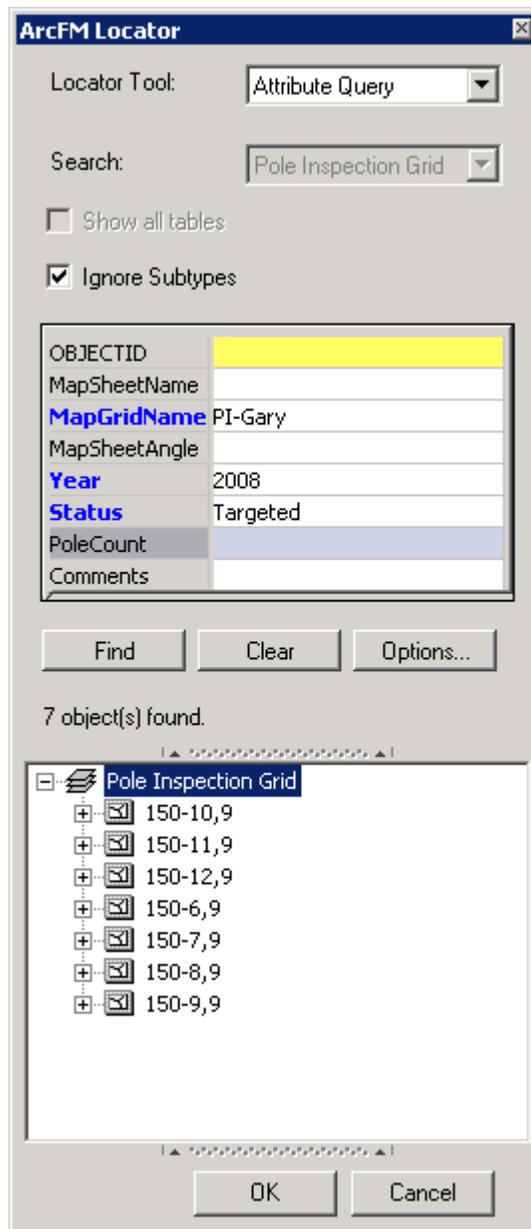
Figure 6.7-2.

8. Click OK to add the located grids to the map set as shown in Figure 6.7-3.
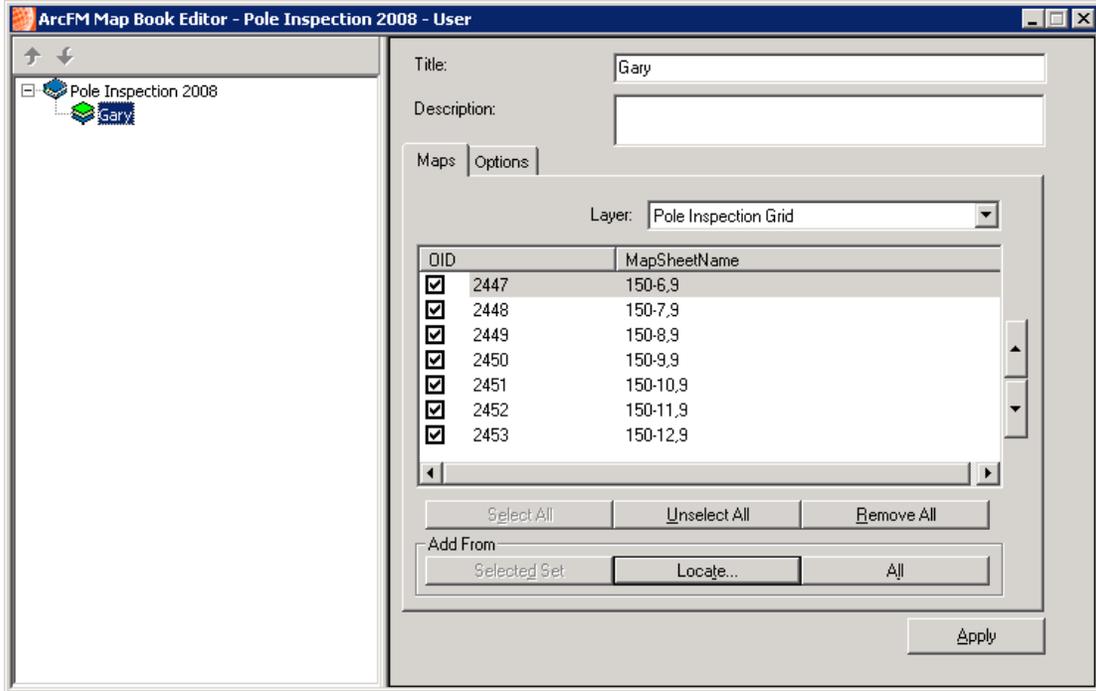
Figure 6.7-3.

9. Set up the options tab as shown in Figure 6.7-4 setting the stored display and page template appropriately:
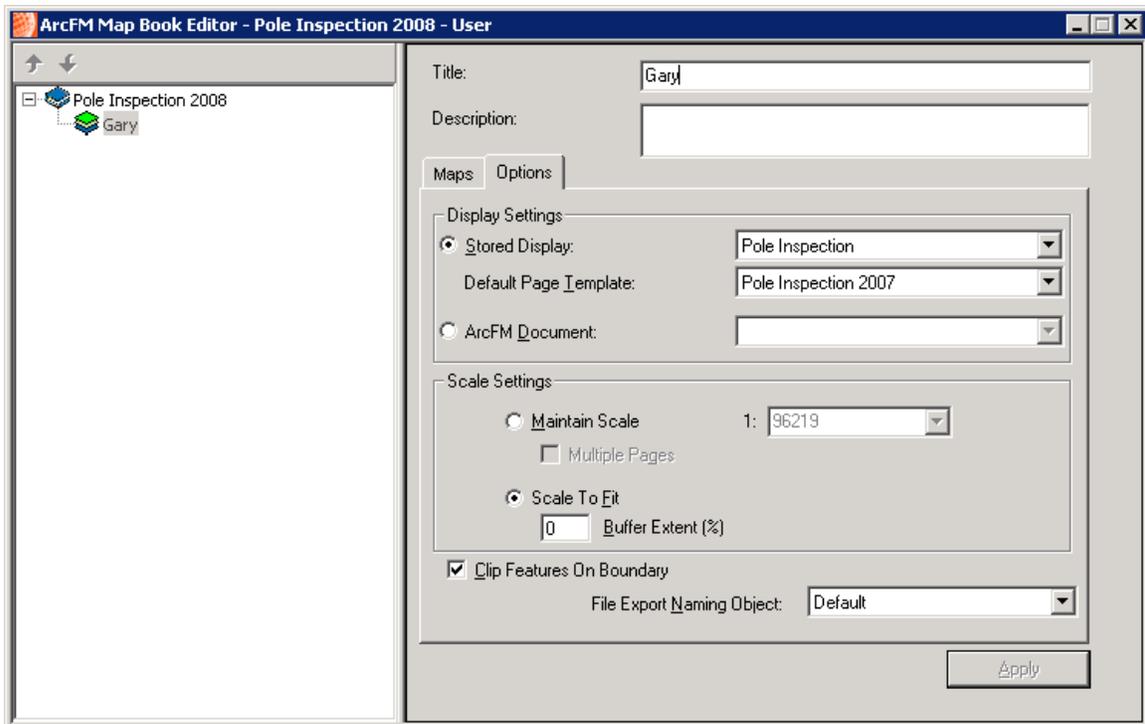
Figure 6.7-4

10. Save the Map Book after setting up map sets for each LOA.

The maps can now be printed. It is recommended that each LOA map set is printed individually instead of printing the entire map book at one time. Once printed, the paper maps should be reviewed to ensure aesthetics for use in the field. Pole number label clipping has been an issue for poles right on the border of the Pole Inspection Map grid. This issue can be solved by regenerating specific map grids after making changes to the options.

Once complete, the paper maps should be delivered to the Electric Standards Department.

6.8 Overview Map Sheet Creation for Each LOA With All Selected Grids

A base map is created for reference to illustrate the total number of GRID cells within the LOA. This LOA level reference map contains the following:
- LOA boundaries
- Previously inspected GRID cells
- Selected GRID cells proposed for inspection in current year.

Within the user ArcFM Stored Documents a Pole Inspection Stored Document exists for each LOA. These will be updated as needed (new entries within inspection layers for new years and update the date in the title). The Pole Inspection Stored Documents will be printed and provided to the Electric Standards Department along with the individual grid maps.

6.9 Full Overview Map Creation for the Service Territory

Similar to the previous section, a larger scale map of the entire area is created showing the following:
- LOA boundaries
- GRID cells with pole totals displayed in the center
- Previously inspected GRID cells
- Selected GRID cells proposed for inspection in current year.

An ArcFM stored document has been created for this plot – "PoleInspection-All LOAs". This stored document will be updated as needed (new entries within inspection layers for new years and updated date in the title). This map will be printed and provided to the Electric Standards Department along with the other paper maps.

6.10 Publish Pole Inspection Field Browser for Each LOA

The AEDR Field Browser (ArcReader) will enable viewing of the maps electronically without the need to view the paper maps. Use the ArcMap Publisher extension to create ArcReader.pmf files for each LOA that contain the data that was included in the detailed inspection paper maps.

6.11 Database / Spreadsheet Creation of Poles to be Inspected

Create an MS Access, or MS Excel table with the following row information:
- Pole Number
- Pole Size
- Class
- Year
- LOA
- Last year inspected

This database/spreadsheet should be provided to the Engineering Standards Department along with all of the maps. This can be accomplished by loading any stored display that shows the targeted pole inspection grids. Use the ArcFM locator tool to select all "targeted" pole inspection grid features for the current year. This selection should exclude grids that have 0 poles for inspection. Once the grids are selected, open the modPoleInspection.bas file and run the WriteOutAttributesOfInspectionPoles method. This method will generate a CSV file within C:\Temp folder that contains all required data for the inspection poles. This CSV file can then be opened and saved in Excel or in MS Access.

6.12 Pole Inspection Data Load into the AEDR ArcGIS Geodatabase

The electric standards department will deliver the inspection results data back to the GIS team near the end of each year. These steps describe the process to load the NIPSCO Pole Inspection data results back into the AEDR ArcGIS geodatabase.

1. The data is delivered by the Engineering Standards Department to the GIS team in the form of a Microsoft Access database. The database had the following tables describing the inspection data (each with the same format):
   a. Angola
   b. Crown Point
   c. Gary
   d. Goshen
   e. Hammond
   f. LaPorte
   g. Monticello
   h. Plymouth
   i. Valparaiso

2. Though each table has many fields, we are only interested in a small subset. The first step is to create a single table to hold all of the records that need to be loaded with the subset of the available fields. The name of the table created was tbNIPSCO2006 with the design shown in Figure 6.12-1.

a.

Field Name	Data Type
ID	AutoNumber
Date	Date/Time
PoleNo	Text
VisRej	Text
SandBRej	Text
ExcNoD	Text
ExcWD	Text
ExcRej	Text

Figure 6.12-1

b. NOTE: the autonumber ID field was added so that each record would receive a unique ID. This assisted in determining duplicate pole records as well as tying pole number mismatches back to the original source record.

3. Load the tbNIPSCO2006 table with the required data from the other LOA tables as follows:

a. Run the INSERT INTO tbNIPSCO2006 query.

b. Run this statement via an Access Query for each LOA replacing "LOA" with the appropriate LOA table name.

4. Once the tbNIPSCO2006 table has all of the records to be loaded, it requires review for any duplicate pole numbers as they will need to be handled separately.

a. Create a new table in the database by copying and pasting tbNIPSCO2006 into a new table called DuplicateRecordsNotProcessed.

b. Next, identify the duplicates by running the SELECT DISTINCT POLE query against tbNIPSCO2006. This will return all of the duplicate pole numbers and provide a count of the duplicates.

c. Inspectors correct any duplicates and return the data back to the Engineering Standards Department. Any remaining duplicates are field checked by the Records Department.

d. If any records are returned, copy and paste the pole numbers to a query that will copy all of their data into the duplicate table for later review.

e. Next, run another query to remove the duplicate records from tbNIPSCO2006 so that they will not be processed during the load.

5. Next, create a new table called tbNIPSCO2006_RecordsNotInGIS by copying and pasting the table structure tbNIPSCO2006. This table will be used by the load process to record any records that do not have matching pole numbers in the GIS.

Open the new table in design mode and change the type of the ID column from autonumber to just number. This will preserve the ID of the source record.

6. Get latest code and executable to load the pole data into the GIS from the AEDR SourceSafe database.

7. Open the DataConnectionInfo.xml via a text editor and verify/modify the following values:

    a. GIS connectivity: <gis server="aedrdbsqlp01" service="9999" database="arcfm8">

    b. GIS version to load data into: <version key="InspectionDataLoad" name="SDE.InspectionDataLoad">

    c. GIS SQL Access: <gisDb connectionString="Data Source=aedrdbsqlp01;Initial Catalog=arcfm8; Connect Timeout=120;" />

    d. Local path to the inspection database: <fieldInventory mdbPath="C:\AEDR\NIPSCO2006Inspection.mdb" />

8. Run the application InspectionDataLoad.exe from the <$\Software Development\DataLoaders\InspectionDataLoad\bin\Release\> folder.

9. The application will take the following steps:

    a. Open the GIS version for editing.

    b. Open a connection to the access Inspection database.

    c. Truncate the tbNIPSCO2006_RecordsNotInGIS table (emptied in case this application is run multiple times).

    d. Pull all records out of the tbNIPSCO2006 table.

    e. Loop thru the inspection records and:

        i. Try to match the pole number to the GIS support structure table. If a match is found, continue. If not it will copy the data into the tbNIPSCO2006_RecordsNotInGIS table for later review.

        ii. Check if ExcNoD or ExcWD is "Y". If so, create a ground treatment record in woodpoleevents recording the pole number and the ground treatment date from the source Date field.

        iii. Create a pole inspection record in woodpoleevents. If VisRej, SandBRej, and ExcRej are all empty, the inspection is marked as passing (WOODPOLEINSPECTIONPASSFAILCD='N'). Use the year of the Date field for the inspection year.

    f. Save all edits.

    g. Log all processing to the InspectionDataLoaderDate/Time log.

10. The resulting database and log file will then be made available to the inspection business owners for review.

11. At a future date when the duplicates are cleaned up, they will be pasted by themselves into the tbNIPSCO2006 table and the process will be re-run.

6.13 Backup and Recovery

All data created, converted, or maintained by this project is stored on the AEDR system MS SQL server, and backed up with the entire system every night. In addition, every night the server, and the corresponding change logs are backed up to tape (or cartridge). In case of a failure, everything will be able to be rebuilt from these files. The recovery process has been tested several times over the course of production operations by taking a .bak file and restoring it to another instance on the test box.

7 Alternative Energy Studies

7.1 Overview

Task five of this subcontract addresses the additional studies undertaken to enhance the usability of AEDR as related to distributed generation and the high probability regions where interconnection and integration of DR/DG may provide substantive returns on investment.

Additional studies were explored related to biomass and wind energy systems. Both biomass and wind energy were identified as feasible for alternative energy initiative possibilities however wind energy was chosen for further in-depth study because it had been estimated by the wind industry and wind resource advocates that Indiana has at least 40,000 MW of wind energy potential and that estimate is more than double the entire generating capacity of Indiana.

NIPSCO jointly collaborated with the National Renewable Energy Laboratory to help identify potential wind generation sites located within NIPSCO's service territory. Utilizing NREL's Renewable Planning Model and AEDR data, potential wind power areas in proximity to transmission circuits for connection were targeted and assigned wind power classifications. The basis of the Wind Generation Integration Report (see Appendix H) is centered on identifying Northwest Indiana's highest possible wind class (Class 3) locations and providing both the positive and negative aspects for each site. The Report also highlights NIPSCO's advantage for offshore wind generation.

The Wind Generation Integration report was submitted to NIPSCO management for further investigation.

8 Conclusion

While most of the original project objectives were met, some of the development was postponed as the corporate objective changed from simply implementing a GIS at NIPSCO to an enterprise-wide GIS implementation:

- The AEDR is intended to provide workflow transitioning and multiple data views (e.g. existing vs. proposed).
- The AEDR is intended to improve reconciliation efficiency by supporting design posting vs. re-digitizing.
- The AEDR is intended to provide enhanced leak/repair capability.
- The AEDR is intended to provide the additional ability to support digital photos of stations, poles, etc.

However, the vast majority of the objectives were met and enhancements not originally planned, were developed as the business needs arose:

- The AEDR is intended to continue to provide an integrated repository for all outside plant records data and the ability to interface to external systems in addition to new systems for related data.
- The AEDR is intended to provide a platform for the research of Alternative Energy Studies.
- The AEDR is intended to continue to improve network model integrity through strict enforcement of network model/data validation rules and will provide an environment for creating additional rules.
- The AEDR is intended to provide support for compatible unit design and design estimating.
- The AEDR is intended to provide enhanced field functionality to improve data integrity.
- The AEDR is intended to provide geographical information expansion to areas of NIPSCO previously unknown to this technology.

Unexpected Benefits:

- New, valuable tools with far-reaching benefits were surprising easy to develop and implement. Examples of these are the Service Request Process and the Gas Customer Analysis tool.
- New AEDR users are increasing in numbers and they are tapping into the spatial analysis capabilities of the AEDR on a large scale.
- Users are being supported in a big way by a very small support group.

Appendix A

AEDR Deployment Phase II Project Plan

AEDR Deployment Phase II Project Plan

ID		Task Name	Start	Finish	
1	✓	**NIPSCO AEDR Phase II Deployment Project Plan**	**Mon 12/13/04**	**Fri 3/14/08**	
2	✓	**Field Browser Implementation - Phase II**	**Thu 8/31/06**	**Thu 4/26/07**	
3	✓	See AEDR Field Browser Implementation Plan	Thu 8/31/06	Thu 4/26/07	
4	✓	**Facility Browser Implementation - Phase II**	**Mon 12/13/04**	**Fri 5/4/07**	
5	✓	**Facility Browser Environment Setup Tasks**	**Wed 3/8/06**	**Fri 5/4/07**	
6	✓	Facility Browser Env - Research ArcIMS architecture options	Wed 3/8/06	Wed 3/8/06	
7	✓	Facility Browser Env - Document results of the research in ArcSDE & Hardware Architecture Diagram	Thu 3/30/06	Fri 5/4/07	
8	✓	Facility Browser Env - Install / configure ArcIMS	Mon 4/10/06	Wed 4/12/06	
9	✓	**ArcIMS Facility Browser**	**Mon 12/13/04**	**Thu 1/18/07**	
10	✓	Development Part 2	Mon 12/13/04	Fri 1/28/05	
11	✓	Development Part 3 (updates for .BAK and CIS Data)	Mon 2/14/05	Fri 2/25/05	
12	✓	Development Part 4 (Updates to correct deficiencies)	Thu 2/16/06	Fri 3/31/06	
13	✓	Procure new server	Thu 7/6/06	Mon 10/2/06	
14	✓	Build new server	Tue 10/3/06	Wed 10/11/06	
15	✓	Install SQL Server	Wed 10/11/06	Wed 10/11/06	
16	✓	Install ArcSDE	Wed 10/11/06	Wed 10/11/06	
17	✓	Complete the Views	Wed 10/18/06	Wed 10/18/06	
18	✓	Documentation Review & Approval	Tue 10/24/06	Tue 10/24/06	
19	✓	Excess space issue resolution	Tue 10/17/06	Wed 10/18/06	
20	✓	Exess space issue resolution testing	Thu 10/19/06	Thu 10/19/06	
21	✓	Onsite Installation & System Acceptance Testing	Wed 10/11/06	Wed 10/11/06	
22	✓	Install Security Profiles	Tue 10/24/06	Mon 12/11/06	
23	✓	User Acceptance Testing	Tue 10/24/06	Tue 10/24/06	
24	✓	Authoring Tool	Wed 10/18/06	Thu 10/19/06	
25	✓	Implement Replication Process	Fri 10/20/06	Fri 12/1/06	
26	✓	Create Training Schedule	Mon 12/4/06	Thu 1/11/07	
27	✓	Training	Tue 1/2/07	Thu 1/18/07	
28	✓	Implementation	Tue 10/31/06	Fri 12/29/06	
29	✓	**GIS to CAD Export - Part 2**	**Thu 6/21/07**	**Fri 3/14/08**	
30	✓	Identify options to provide ABB interface with small-sized landbase files and make selection	Thu 6/21/07	Tue 7/10/07	
31	✓	Modify Ptarmigan software	Wed 7/11/07	Wed 7/18/07	
32	✓	Test Ptarmigan CAD Converter	Thu 7/19/07	Thu 7/19/07	
33	✓	Generate landbase files and provide to NORS group	Thu 7/26/07	Thu 7/26/07	
34	✓	Train GIS team to use Ptarmigan CAD Converter	Wed 8/1/07	Wed 8/1/07	

AEDR Deployment Phase II Project Plan

ID	ℹ	Task Name	Start	Finish	
35	✓	Modify 3rd Party Requests to use Ptarmigan CAD Converter	Tue 1/29/08	Wed 1/30/08	
36	✓	Finalize 3rd Party Request Instructions in VSS	Fri 3/14/08	Fri 3/14/08	
37	✓	Modify LOA CAD Export to use Ptarmigan CAD Converter	Fri 2/8/08	Mon 2/11/08	
38	✓	Finalize LOA CAD Export Instructions in VSS	Fri 3/14/08	Fri 3/14/08	
39	✓	**Alternative Energy Study**	**Tue 10/3/06**	**Thu 7/19/07**	
40	✓	Gather information to initiate Alternative Energy Study	Tue 10/3/06	Wed 1/17/07	
41	✓	Decision to study Wind Energy	Fri 1/26/07	Fri 1/26/07	
42	✓	Conduct Wind Energy Study using NREL's RPM	Mon 2/5/07	Wed 6/6/07	
43	✓	Develop Wind Energy Study Report	Mon 7/2/07	Thu 7/19/07	
44	✓	Submit Wind Energy Study report to NREL	Thu 7/19/07	Thu 7/19/07	
45	✓	**ArcView Implementation**	**Thu 9/7/06**	**Mon 1/28/08**	
46	✓	Licensing & Configuration	Fri 5/18/07	Thu 5/31/07	
47	✓	Engineering Training	Wed 11/1/06	Tue 7/31/07	
48	✓	Facility Locate Screening Training	Wed 10/3/07	Wed 10/3/07	
49	✓	ESSO Training	Thu 9/7/06	Thu 9/7/06	
50	✓	Integration Center Training	Tue 12/11/07	Mon 1/28/08	
51	✓	Corrosion Control Training	Fri 6/22/07	Fri 6/22/07	
52	✓	Rate Department Training	Tue 2/27/07	Tue 2/27/07	
53	✓	FastPath Engineers for Service Request Training	Tue 6/5/07	Thu 6/7/07	
54	✓	Distribution Engineers for Service Request Training	Wed 6/13/07	Wed 6/13/07	
55	✓	Record Clerks for Service Request Training	Wed 6/6/07	Mon 6/11/07	
56	✓	**Automated Service Request**	**Tue 2/13/07**	**Mon 9/17/07**	
57	✓	Design	Tue 2/13/07	Wed 2/21/07	
58	✓	Development	Fri 3/9/07	Fri 3/9/07	
59	✓	User Acceptance Testing	Wed 8/15/07	Wed 8/15/07	
60	✓	Demo #1	Thu 4/26/07	Thu 4/26/07	
61	✓	Demo #2	Thu 5/3/07	Thu 5/3/07	
62	✓	Demo #3	Thu 5/17/07	Thu 5/17/07	
63	✓	Demo #4	Mon 6/11/07	Mon 6/11/07	
64	✓	Train Clerks and QA/QC Team on Service Requests	Mon 6/4/07	Mon 6/11/07	
65	✓	Train FastPath Engineers on Service Requests	Tue 6/5/07	Thu 6/7/07	
66	✓	Train Engineering on Service Requests	Mon 6/11/07	Wed 6/13/07	
67	✓	Support Clerk Service Request Practice Sessions	Mon 6/11/07	Fri 6/15/07	
68	✓	Implementation into Production	Fri 5/4/07	Fri 5/4/07	

AEDR Deployment Phase II Project Plan

ID	ℹ	Task Name	Start	Finish
69	✓	Deployment	Mon 9/17/07	Mon 9/17/07
70	✓	**CADOPS/FeederAll Phase 2**	**Wed 1/25/06**	**Wed 1/25/06**
71	✓	Develop Operations Guide - See Construction Phase Project Plan	Wed 1/25/06	Wed 1/25/06
72	✓	**Gas Customer Analysis**	**Tue 7/10/07**	**Mon 11/5/07**
73	✓	Initial discussion/requirements gathering meeting	Tue 7/10/07	Mon 8/6/07
74	✓	Develop prototype based on initial discussion	Tue 8/28/07	Mon 9/17/07
75	✓	Transform prototype and apply changes	Tue 9/18/07	Mon 10/15/07
76	✓	Create training materials	Tue 10/16/07	Tue 10/16/07
77	✓	Create Online Help	Mon 10/15/07	Mon 10/15/07
78	✓	Install into Production	Tue 10/16/07	Tue 10/16/07
79	✓	Gas Customer Analysis Training	Tue 10/16/07	Mon 11/5/07

Appendix B

Automated Service Request Test Plan

1   Introduction

The purpose of this test plan is to fully test any affected areas of the functionality tied to the changes made in the specific release.

As the test cases are executed, the tester checks off the boxes of the completed steps. If a step fails, the box is circled and the execution of the test case is halted. Details of any failure results are to be documented in the provided area, the pass/fail indicator circled, and the tester's initials provided in the "Executed By" section. For any failed test cases, an Elementool ticket containing the test case number and details of the failure will be submitted.

2   Updated Functionality

New Functionality: CIS Service Request Automation
The purpose of the Automated Service Request process is to integrate the CIS Service Requests (Electric & Gas) directly into AEDR with the goal of using as much out of the box ESRI and ArcFM functionality as possible. This includes the definition of new workflow, data model updates, and new AEDR components. At a high level the functionality includes:

- Creating New CIS Installed Service Features in AEDR from CIS data
- Auto-Generating an AEDR Service Request form using an ArcFM Page Template
- Auto-populating many fields on the Service Request using ArcFM AutoText
- Managing the workflow of a Service Request via custom AEDR assignment tools
- Exporting a completed Service Request into PDF format
- Linking completed Service Requests to CIS Installed Features via http reference
- Passing completed Service Requests into the existing Gas Service Card Viewer

3   Test Environment

These tests should be executed within the current AEDR test environment as detailed below.

- Use a Citrix ArcMap client from aedrmapcrx01
- Connect to the Dev database:
  - Server = aedrmapgis01
  - Service = 9999
  - Database = arcfm8
  - Session Manager SQL Server = aedrmapgis01\dev
  - Session Manager Database = px
  - User = windows authentication

4 Test Cases

4.1 *New Functionality: CIS Service Request Automation*

This test should be performed by 2 testers, one tester configured as a record clerk and another configured as an engineer. This testing utilizes the proposed workflow for the new CIS service request creation.

4.1.1 Create new CIS Installed Service Features

☐ Open session manager.
☐ Create a new session.
☐ Set the session type to CIS Services.
☐ Open the session in the GIS.
☐ Locate and click the Create CIS Installed Services button. The create services form will be displayed.
☐ Input a site id into the create services form and click the "Search for New CIS Services" button. The system will query the CIS interface tables for any matching pending records.
☐ Any matching pending records will be displayed on the form.
☐ Select one or more records in the grid.
☐ Click the Zoom to Approximate Area button. If the selected record(s) have the grid code populated, the application will first use it to zoom to the minor grid. If the selected record(s) have a load number populated, the application will then attempt to zoom in further based on any matching poles or pads.
☐ Review the other information available in the grid to further find the location of the service (lot number, address, etc).
☐ Select one record in the grid or multiple records in the grid.
☐ Click the Set X/Y button. When you mouse over the map, your cursor will be a crosshair.
☐ Click the map to set the X/Y location for the selected record(s). If you have multiple records selected, the same X/Y will be assigned to all selected records. Alternatively you can assign X/Y coordinates one at a time to the records in the grid. When you click the map, the clicked location should flash blue and the X/Y Coordinates field will be populated in the grid for the selected record(s).
☐ Once you are satisfied with the X/Y coordinates, click the "Create Features" button. New CIS Installed Service points will be created on the map. The records will also be removed from the grid.
☐ Select the newly created CIS installed service feature and review both the feature and the related site object in the ArcFM attribute editor. The data will match the pending CIS record.
☐ Repeat the above steps for several more CIS Site ids (with the same session).
☐ Save the session.
☐ Continue on to the next test.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____
If the test case failed please detail the failure results here:

4.1.2 Create new Service Requests

☐ Select one of the newly created CIS installed service points (you may need to use the ArcFM locator to zoom back to the location via the site id). Ensure you only have one feature selected.

☐ Drop down the Service Requests drop down and click the Load Template button. The system should load the appropriate stored display and page template and will automatically refresh the ArcFM autotext elements.

☐ Review the ArcFM autotext elements and ensure they match the available data (use the ArcFM Attribute Editor to compare the data if needed):

- Service Request Type
- Site Id
- Customer Name
- Address
- LOA
- Municipality Name
- County Name
- Township Name
- Tax Unit
- Grid Cd
- Development Name
- Lot #

☐ Use the standard ESRI drawing toolbar to add additional text as needed.

☐ ArcFM Autotext can be resized or deleted using the standard ESRI tools.

☐ Zoom the map in to an appropriate zoom level and extent.

☐ Drop down the Service Requests drop down and click the Save button.

☐ If you are still in the original session, the system will warn you that the service request can be created but can not be sent to an engineer or completed until the session has been posted.

☐ Drop down the Service Requests drop down and verify that the new service request appears there in the "New" state and marked appropriately as Gas/Electric.

☐ Note the site id and the LOA for use in later tests.

☐ Repeat the above steps for the remaining new CIS installed service features.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____

If the test case failed please detail the failure results here:

4.1.3 Submit the Session
☐ Submit the session. Choose any approval officer.
☐ Wait up to 5 minutes. The session will be auto-approved and posted via the BRP service.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____
If the test case failed please detail the failure results here:

4.1.4 Open a Service Request & Send to an Engineer
☐ Complete these steps without being in a Session.
☐ Drop down the Service Requests drop down and click on one of the new service requests assigned to you.
☐ The service request should load with all edits previously made and saved.
☐ Invoke the Service Requests drop down and click the Send and Notify button. The send and notify form should be displayed.
☐ Select the engineer that is working as a tester with you.
☐ Click the Save button. The service request will be saved and transferred to the selected engineer. A blank page template will be loaded to indicate that the service request is not open anymore.
☐ Drop down the service requests drop down and verify that the service request is no longer there.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____
If the test case failed please detail the failure results here:

4.1.5 Make Engineering Updates
- ☐ Complete these steps without being in a Session as the Engineer user.
- ☐ Drop down the Service Requests drop down and click on one of the Engineering service requests assigned to you.
- ☐ The service request should load with all edits previously made and saved by the clerk.
- ☐ Use the standard ESRI drawing tools to update text and draw the proposed service on the map.
- ☐ Click the Save button. Click yes to replace the current version.
- ☐ Once edits are complete, print the service request to a local printer. Verify that the service request looks as expected. This paper copy would be distributed to a field crew for installation and as-built updates.
- ☐ Drop down the Service Requests drop down and click the Send and Notify button. The send and notify form should be displayed.
- ☐ Click the Save button. The service request will be saved and transferred to a pending as-built updates queue. A blank page template will be loaded to indicate that the service request is not open anymore.
- ☐ Invoke the service requests drop down and verify that the service request is no longer there.
- ☐ Repeat the above steps for any other assigned Engineering service requests.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____

If the test case failed please detail the failure results here:

4.1.6 Make As-built Updates and Complete
- ☐ Complete these steps without being in a Session as the Clerk user.
- ☐ Invoke the Service Requests drop down and click on the View Pending As-Built button.
- ☐ A form will be shown and the system will query the database for all pending As-Built service requests.
- ☐ Invoke the LOA drop down and select the appropriate LOA based on the service requests that were created earlier.
- ☐ All service requests pending as-built updates within the chosen LOA will be shown.
- ☐ Select one of the service requests.
- ☐ Click the assign and load button.
- ☐ The service request should load with all edits previously made and saved by the clerk and the engineer.
- ☐ Drop down the service requests drop down and confirm that the service request is now assigned to you in the as-built state.
- ☐ Use the standard ESRI drawing tools to update text and make any required as-built updates from the field.

- ☐ Click the Save button. Click yes to replace the current version.
- ☐ Invoke the service requests drop down and click the Complete button. The system should warn you that you must be editing in a session to complete a service request.
- ☐ Open session manager.
- ☐ Create a new session with Type=CIS Services.
- ☐ Open the session in the GIS.
- ☐ Invoke the service requests drop down and click the COMPLETE button. The system will prompt you to confirm your choice to complete the service request. Choose YES to continue.
- ☐ The system will export the service request to a PDF format and will save the PDF to a remote server location. The file reference to the PDF will be saved into the Service Card link field on the installed service feature. The blank page template will be loaded to indicate that the service request is no longer open.
- ☐ Click the ESRI button to return to the Data view.
- ☐ Click on the hyperlink tool (lightning bolt) to activate it.
- ☐ The CIS installed service feature should turn blue on the map indicating it has a linked document available.
- ☐ Use the hyperlink tool to click on the installed service feature. The remote PDF document should be loaded and displayed. Review the document for correctness.
- ☐ Note the LOA, Municipality, and Address for use in the next test.
- ☐ Repeat the above steps for several more pending as-built updates service requests.
- ☐ Submit the session to any approval officer. It will be auto-approved and posted via the BRP service.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____
If the test case failed please detail the failure results here:

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4.1.7 View the Service Request via the Gas Service Card Viewer

- ☐ Have the test lead provide the link to the test version of the Gas Service Viewer application.
- ☐ Choose the LOA
- ☐ Choose the City or County/Township
- ☐ Choose Street Name
- ☐ All available service cards available for the selected street will be displayed on the left.
- ☐ Find the matching address. There should be a link called "View PDF"
- ☐ Click the link. The PDF should load in the web browser.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____
If the test case failed please detail the failure results here:

4.1.8 Delete a Service Request

- ☐ Use the skills learned above to create a new Installed Service Point.
- ☐ Use the skills to create a new Service Request.
- ☐ Save the Service Request.
- ☐ Verify that the new service request is available in your Service Requests drop down.
- ☐ Invoke the Service Requests drop down and select Delete.
- ☐ Confirm the deletion.
- ☐ The system will delete the service request and will load the blank template to indicate that you are no longer in the service request.
- ☐ Verify that the service request is no longer in your Service Requests drop down.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____

If the test case failed please detail the failure results here:

4.1.9 Update (Reassign) Service Request Owners

- ☐ Log into the test SAGE site as a coordinator user OR a user who has been assigned a role with the Assign Service Request (Clerk/Eng) permission.
- ☐ Load the Coordinator → Reassign Service Requests – Clerk page
- ☐ Click the Arrow button next to several of the test clerks listed.
- ☐ The service requests assigned to that clerk should be displayed in the right hand list box.
- ☐ Choose a user for whom to reassign a service request and load their service requests.
- ☐ Select one of their service requests in the list box.
- ☐ Below the list box, choose another clerk user.
- ☐ Click the Reassign Service Requests button.
- ☐ The chosen service request should be removed from the list box.
- ☐ Click the arrow next to the user just reassigned the service request.
- ☐ The reassigned service request should appear in the list box.
- ☐ Repeat as desired to fully test this functionality.

☐ Load the Coordinator → Reassign Service Requests – Engineer page.
☐ Repeat the same tests to reassign service requests within the engineering group.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____
If the test case failed please detail the failure results here:

4.1.10 Ad Hoc Testing
☐ Use the skills you have learned throughout the above testing to run some ad hoc testing until you feel comfortable with the application.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____
If the test case failed please detail the failure results here:

Appendix C

Gas Customer Analysis Test Plan

1 Introduction

The purpose of this test plan is to fully test any affected areas of the functionality tied to the changes made in the specific release.

As the test cases are executed, the tester checks off the boxes of the completed steps. If a step fails, the box is circled and the execution of the test case is halted. Details of any failure results are to be documented in the provided area, the pass/fail indicator circled, and the tester's initials provided in the "Executed By" section. For any failed test cases, an Elementool ticket containing the test case number and details of the failure will be submitted.

2 Test Cases

2.1 Enhancement: Gas Customer Analysis and Export Tools

Load the Gas OMS stored display. You do not need to be in session (do not need to be editing) for these test cases.

2.1.1 Select Gas Mains and Review Selection Details

☐ Zoom into any area where there are distribution or transmission gas main features.
☐ Use the select tool to select several gas mains (note, the gas main layers are the only selectable layers in the Gas OMS stored display so you can draw a large selection box and will only get back gas main features).
☐ Locate the "Gas Customer Analysis" button at the far right of the AEDR Tracing toolbar. It looks like this:
☐ Click the button. The Gas Customer Analysis window should open.
☐ Near the top of the form, you should see a label that says "Selected Gas Mains: #" followed by the selection details section which shows how many of each type of pipe you have selected (low, medium, high pressure, or transmission). Verify that the displayed details match the gas mains that you selected.
☐ Leave the form open, zoom to a new location, and select a different set of gas mains (note the Gas Customer Analysis window will stay on top of the GIS window).
☐ As you change the selection in the GIS, the selection details on the Gas Customer Analysis window should be automatically updated.
☐ Zoom to several more areas on the map and change the selection of gas mains. Ensure the Gas Customer Analysis window is always updated correctly.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by
If the test case failed please detail the failure results here:

2.1.2 Create Gas Main Buffer

☐ Select some set of gas mains and ensure the Gas Customer Analysis tool is open.
☐ The buffer section of the tool is directly below the selection details. The default value is set to 100.
☐ Click the Draw Buffer button.
☐ The map should be refreshed with a 100 ft buffer displayed around all of the selected pipe.
☐ Drag the buffer distance slider to a higher value around 150.
☐ Click the Draw Buffer button.
☐ The buffer on the screen should be updated to reflect approximately 150 ft in all directions from the selected gas mains.
☐ Click the Clear Results button.
☐ The buffer should be cleared from the screen.
☐ On the map, select two sets of gas mains that are not connected (to prove the point, make sure they are greater than 150 ft apart).
☐ Click the Draw Buffer button.
☐ Individual buffers should be drawn around both sets of gas mains. If the buffers are close enough to touch, they will be merged together.
☐ Experiment with different selected sets of gas mains and the buffer tool at different distances. Ensure that each time the buffer is drawn correctly on the screen.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by

If the test case failed please detail the failure results here:

2.1.3 Get Customers from Buffer

☐ Using the skills from the above buffer test case, select a set of gas mains, and create a buffer that is big enough to encompass most of the surrounding gas installed service points.
☐ In the Customer Tools section, click the Get Customers from Buffer button.
☐ The status at the bottom of the form will indicate that it is loading the services.
☐ The screen will refresh and there should be small orange colored dots on all of the installed services that exist within the buffer.

- ☐ The detail pane on the Gas Customer Analysis tool will be populated with all of the details of the installed service features that were found within the buffer. The default sort order will by street and then Hse #.
- ☐ Click the various columns to sort by the different fields. The first click will sort the data in ascending order and the second click of the same column will sort in descending order.
- ☐ You can always click the Get Customers From Buffer button to get the customers with the default sort.
- ☐ Click and drag the column headers to reorder the columns in the detail grid. These settings are persisted throughout your current session.
- ☐ Position the Gas Customer Analysis window so you can see both it and the GIS.
- ☐ Click on the first record in the grid. The corresponding installed service feature should flash red on the map.
- ☐ Click additional records in the grid OR just use your down button on the keyboard to select each record in the grid. As each record is selected, the corresponding feature should flash red on the map giving you a visual indicator to where the record is located.
- ☐ Experiment with different size buffers and the retrieval of the customers within those buffers until you are comfortable with this functionality.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by

If the test case failed please detail the failure results here:

2.1.4 Remove and Add Customers to List

- ☐ Based on the previous test case, you should have a buffer created on the map and have gas customers listed within the grid on the Gas Customer Analysis window.
- ☐ If you have more than one street listed in the grid, locate the street with the fewest entries.
- ☐ Click on each record in the grid to visually locate them on the map.
- ☐ Select all of the records for that street by holding the SHIFT key while clicking the records in the grid.
- ☐ Click the Remove Selected Customers button.
- ☐ The selected service records should be removed from the grid, the map should refresh, and the removed services should no longer have an orange dot on top of them indicating that they are no longer part of the selection set.
- ☐ Now click the Add Customers button and move your mouse over the map. Your cursor should be a crosshair.
- ☐ Click and drag a box around the service features that you just removed from the selected set.
- ☐ Any installed service features within the box you drew should be added back to the selected list and their locations on the map should be colored orange.
- ☐ Click the Add Customers button again.

☐ Click and drag a box around a few service features that are outside the buffer area.
☐ The additional features should be added to the list and colored orange on the map. If it is not apparent that they have been added to the list, locate the street and click on the records to see them flash on the map.
☐ These tools allow you to manually add or remove any set of installed services from the selected set.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by

If the test case failed please detail the failure results here:

2.1.5 Search CIS for Missing Services

☐ From the previous test cases, you should have the Gas Customer Analysis window open with a set of installed services shown in the detail pane.
☐ The search CIS button was included to allow the user to search the CIS tables for any CIS service records that may exist in CIS but have not been created on the map. When you click the button, it will first determine the address ranges to use as search parameters against the CIS. It will filter by the street (house) numbers and will also determine if it should search only odd addresses, only even addresses, or both.
☐ Click the Search CIS button.
☐ The CIS Search Details prompt should be shown with address ranges shown for each street currently included in your selected set of services. If the current set of addresses on any given street only includes odd or even addresses, the appropriate radio button will be pre-checked. If the addresses include both odd AND even addresses, both will be checked.
☐ Click Search without changing the default radio button selections.
☐ The application will search the CIS for any missing service record.
☐ A message box will be shown indicating how many missing records were located. If you accepted the default odd/even selections, very few or no additional records may be found.
☐ Click the search CIS button again.
☐ This time, change a few of the odd/even selections to both and click search. This should ensure some additional records are located.
☐ Click OK on the resulting message box.
☐ Scroll all the way to the right of the detail pane and you will see that there is a column called Source. A value of Map indicates that the service came from the map while a value of CIS indicates it came directly from the CIS tables. You can sort the data by this column to more easily review the records if needed.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by

If the test case failed please detail the failure results here:

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2.1.6 Export Data to Excel

☐ From the previous test cases, you should have the Gas Customer Analysis window open with a set of installed services shown in the detail pane.

☐ Click the Export Data to Excel button.

☐ A file prompt will save file prompt will be shown.

☐ Click on the My Computer button on the left.

☐ If you connected to Citrix correctly you will see both the local drives on the server as well as your own local computer drives toward the bottom of the list. For example, you should see something similar to "C$ on 'Client' (T:)" which is a direct link to your personal computer's C: drive.

- If you don't see these options, double click the Citrix icon in the application tray to bring up the Connection Center. Select the server (server name) and on the right, click the File Security button. This will then display a form that will allow you to grant Citrix Full Access to your local machine. Click OK and try again.

☐ Select the C: drive on your Client or some other appropriate local drive.

☐ Accept the default name of AEDRGasCustomerAnalysis.xls or choose a different name.

☐ Click the Save button.

☐ The application will export all of the data contained in the detail pane into an Excel spreadsheet at the location you specified.

☐ When the export is complete, the status on the Gas Customer Analysis window (lower right) will say "Ready – Export Complete".

☐ Browse to that location on your local hard drive and locate the filename that you just exported.

☐ Double click the file to open it in Excel. If any warnings are shown, click YES to open the file.

☐ Excel should display a formatted spreadsheet of data with all of the data from the detail pane. The default sort order will be by street and then house number. There should be a summary at the top containing the timestamp of the export, the total count and the user who exported the data.

☐ Review the data in Excel to make sure it looks correct.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by

If the test case failed please detail the failure results here:

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2.1.7 Generate Outage Forms

- ☐ From the previous test cases, you should have the Gas Customer Analysis window open with a set of installed services shown in the detail pane.
- ☐ The Generate Outage Form button allows you to specify the number of field employees that will be working the outage and then the application will logically divide up the installed services between the field employees and create an individual outage form for each engineer.
- ☐ Set the # field to some number greater than 1. 3 or 4 are good numbers to test with.
- ☐ Click the Generate Outage Form button.
- ☐ A file prompt will save file prompt will be shown.
- ☐ Click on the My Computer button on the left.
- ☐ If you connected to Citrix correctly you will see both the local drives on the server as well as your own local computer drives toward the bottom of the list. For example, you should see something similar to "C$ on 'Client' (T:)" which is a direct link to your personal computer's C: drive.
  - If you don't see these options, double click the Citrix icon in the application tray to bring up the Connection Center. Select the server (server name) and on the right, click the File Security button. This will then display a form that will allow you to grant Citrix Full Access to your local machine. Click OK and try again.
- ☐ Select the C: drive on your Client or some other appropriate local drive.
- ☐ Change the name of the file to be something similar to "OutageForm".
- ☐ Click the Save button.
- ☐ The application will export all of the data contained in the detail pane into Excel spreadsheets at the location you specified.
- ☐ When the export is complete, the status on the Gas Customer Analysis window (lower right) will say "Ready – Export Complete".
- ☐ Browse to that location on your local hard drive.
- ☐ There should be new spreadsheets at that location with names starting with the name you chose. If "OutageForm" was used and you chose 3 field employees, then you will see three files: OutageForm-1.xls, OutageForm-2.xls, and OutageForm-3.xls.
- ☐ Double click each file to open it in Excel. If any warnings are shown, click YES to open the file.
- ☐ Excel should display a formatted NIPSCO GAS OUTAGE FORM with a subset of the data from the detail pane. Each spreadsheet should have roughly the same number of service entries.
- ☐ Review the data in Excel to make sure it looks correct.
- ☐ Note that the application attempts to route each field employee's service entries in a logical order. The first spreadsheet should start at the left most service on the map and it will attempt to have the engineer work up one side of a street and then down the other side. It is not perfect but it works better than manually having to organize the services. You can view this by taking each address from the outage form, finding it in the detail pane of the Customer Analysis window, and clicking on the entry to flash it on the map. Most issues will occur when jumping between streets as the application tries to find the next closest service.
- ☐ Feel free the re-export the outage forms while selecting a different number of field employees to compare the results.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by

If the test case failed please detail the failure results here:

2.1.8 Misc

- ☐ From the previous test cases, you should have the Gas Customer Analysis window open with a set of installed services shown in the detail pane.
- ☐ Click the Maximize button in the upper right hand corner of the Gas Customer Analysis form to maximize it to full screen. Note that the detail pane resizes to a maximum size for easy review of the data.
- ☐ Restore (undo-maximize) the window so you can see the window and the GIS again.
- ☐ Click the X button in the upper right to close the window. All buffer and installed service (orange) graphics should be removed from the screen.
- ☐ Click the "Gas Customer Analysis" button at the far right of the AEDR Tracing toolbar. It looks like this:
- ☐ The window should reappear with the Gas customer data still loaded and the buffer and installed service (orange) graphics should be redrawn on the screen. The application maintains the current settings even while temporarily closed.
- ☐ Click the Clear Results button.
- ☐ All installed service data should be removed from the detail pane and the graphics should be removed from the map. The data has been permanently cleared.
- ☐ Click the X button to close the Gas Customer Analysis.
- ☐ You have completed the test cases for this new application.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by

If the test case failed please detail the failure results here:

Appendix D

Facility Browser Test Plan

1   Introduction

This document describes the test plans to be run during the System Acceptance Testing (SAT) to determine if the Facility Browser replacement functionality meets the planned implementation. Upon successful execution of the test plans within this document, the functionality will be deemed ready for production and NIPSCO will formally accept the application(s) as being complete.

The Facility Browser replacement functionality is a migration of the base software architecture from AutoDesk's MapGuide to ESRI's ArcIMS. Additionally, the underlying core development environment changed from the MapGuide API and ColdFusion to ArcXML and C#.Net. Other enhancements were made to the application that brought it to a more modern software development

While progressing through the test cases, the Tester checks off the boxes of the completed steps. If a step fails, "FAIL" is circled and test case execution is halted for that step. Failure results are to be detailed in the provided area. For every test case executed, the appropriate PASS/FAIL indicator is circled and the "Executed By" is initialed. For any failed test cases, an Elementool bug is submitted with the test case number and details of the failure.

2   Facility Browser Test Cases

2.1   Zoom In - Drag
   ☐ Select *Zoom In* button.
   ☐ Click and Drag a rectangle over the desired location on the map.
   ☐ Map Screen will zoom in to the extent of the rectangle.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____
If the test case failed please detail the failure results here:

2.2   Zoom In - Click
   ☐ Select *Zoom In* button.
   ☐ Click on the desired location on the map.
   ☐ Map Screen will zoom in, centered at the click point.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____
If the test case failed please detail the failure results here:

2.3   Zoom Out

☐ Select *Zoom Out* button.
☐ Click on the map.
☐ Map screen will zoom out and be centered on the click point.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____

If the test case failed please detail the failure results here:

2.4   Pan - Drag

☐ Select *Pan* button.
☐ Click and drag the map.
☐ The map will be refreshed.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____

If the test case failed please detail the failure results here:

2.5   Pan - Click

☐ Select *Pan* button.
☐ Click on the map.
☐ The map will be centered at the click point.

Test Case Results (circle/highlight one): [PASS /   FAIL] Executed by_____

If the test case failed please detail the failure results here:

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2.6   Identify Map Features

☐ Select *Identify Map Features* button.
☐ Click on map screen. 'Identify Results' screen will appear.
☐ Click the '+' next to feature headings to display feature list.
☐ Click desired feature. Feature will flash on map screen and values will appear in 'Identify Results' box.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____

If the test case failed please detail the failure results here:

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2.7   Measure Distance

☐ Select *Measure Distance* button.
☐ Click on desired starting location.
☐ Move cursor to desired finishing location.
☐ For multiple segments, click again and move cursor to new finishing location.
☐ The results of the measurement will appear in the upper-left corner of the map.
☐ Press *Esc* key to clear.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____

If the test case failed please detail the failure results here:

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2.8   Get XY Coordinate

☐ Select *Get XY Coordinate* button.
☐ Click on desired location of the map.
☐ XY coordinates for chosen location will open in a dialog.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____
If the test case failed please detail the failure results here:

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2.9 View Full Extent
☐ Click the *View Full Extent* button to return to original extent of the map.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____
If the test case failed please detail the failure results here:

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2.10 Previous View
☐ Click the *Previous View* button to go to the previously viewed map extent.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____
If the test case failed please detail the failure results here:

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2.11 Zoom Forward
☐ Click *Zoom Forward* button to go forward one map extent (this will only work if a Zoom Previous has been done).

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____
If the test case failed please detail the failure results here:

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2.12 Bookmarks

To Add a Bookmark
- ☐ Click the *Bookmarks* button.
- ☐ Click 'Add Bookmark.'
- ☐ Enter a name for the bookmark.
- ☐ Select 'OK' to continue with the naming of the bookmark or 'Cancel' to stop the naming. If you continued with the naming, the name you entered will appear in the *Bookmarks* list.

To Remove a Bookmark
- ☐ Click the *Bookmarks* button.
- ☐ Click the *Delete Bookmark* button next to the bookmark name that is to be removed. The selected bookmark will disappear from the bookmark list.

To View a Bookmark
- ☐ Click the *Bookmarks* button.
- ☐ Click the *Zoom to Bookmark* button next to the bookmark name that is to be viewed. The map screen will go to the selected bookmark's location.
- ☐ Go to another computer and go to the Facility Browser address. Click the *Bookmarks* button. Click the *Zoom to Bookmark* button next to the bookmark name that was just created in the steps above.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____

If the test case failed please detail the failure results here:

2.13 Map Legend

- ☐ Click on *Map Legend* button.
- ☐ To select layers that will appear on the map, click the box next to layer name. A 'check' in the box means the layer will appear on the map.
- ☐ Click *Refresh* to display selected layers on the map.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____

If the test case failed please detail the failure results here:

2.14 Full Screen

- ☐ Click *Full Screen* button to use entire screen to display map.

☐ Click *Full Screen* button again to exit *Full Screen*, and return to original screen size.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____

If the test case failed please detail the failure results here:

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2.15 Overview Map

☐ Click *Overview Map* button to display the location of the current map screen. The red box on the 'Locator Map' is the location of the current map screen.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____

If the test case failed please detail the failure results here:

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2.16 Zoom To

☐ Click on 'Select.' This activates drop down menu.
☐ Click on desired layer to select it.
☐ For 'LOA' or 'Political Township' click on new drop down menu and click on desired name. Then click 'Go.' For 'County' or 'Minor Grid' or 'Municipality' enter the desired name to zoom to. Then click 'Go.' The Minor Grid code must be five characters long.
☐ If a feature is found matching the criteria, the map will zoom to selected feature.

Test Case Results (circle/highlight one): [PASS / FAIL] Executed by_____

If the test case failed please detail the failure results here:

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2.17 Queries

Query Dialog
☐ Follow these instructions for each one of the features in the following list.
☐ Click the '+' next any of the headings to display list of queries.
☐ Click on one of the features to launch a query dialog box.

☐ For text box entry, type in search criteria, enter the valid value for the attribute specified for each feature in the list below. For the drop-downs, choose the appropriate value listed below.

☐ Pick one of the records returned from this query report and click on the "identify" button on the left side of the report window. Leave this window open and use the values in the next steps.

☐ Use the clear selection button to clear the report.

☐ Re-launch the query for the feature you are testing. Clear the query window and enter one of the valid values you have written down and click execute. This must be repeated for each field using the valid values written down in the step above.

Report Results

☐ This only needs to be done for the first query of each feature.

☐ Click 'Zoom to Feature on Map' icon to have map screen zoom in to specific feature.

☐ Click 'Display Feature Details' icon to display "Identify Results' box for specific feature.

☐ Click 'Flash Feature on Map' icon to have specific feature flash in red on map screen.

☐ Click 'Next' to view additional records. Click 'Back' to view previous records.

☐ To select the number of records displayed at a time, click the '25,' '50' or '100' box.

☐ Click the 'Export Report to Excel' button to upload current records list to Excel worksheet.

☐ Click the 'Clear Selection' button to remove current records list.

For CIS Installed Service Query

☐ Click the Site Identification Number to display the Gas Service Card Viewer.

☐ Check the zoom in buttons in the service card viewer.

☐ Check the toggle from card front to card back.

Test Case Results (circle/highlight one):

List of features and valid starting values

CIS Installed Service [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value GA in the Utility Type Code field

Service by Address [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value 603 in the Street Number field

Street   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value 603 in the Street Number field

Street Intersection [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value Walton for Name1 and Frost for Name2

Capacitor Bank   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Dead End Elec   [PASS / FAIL] Executed by _____ Reason for failure _____

Use the value LaPorte in the LOA field

Fuse   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Manhole   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Padmount   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Pedestal   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Prim Open Point   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Primary Meter   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Primary Overhead [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Prim Underground [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Recloser Bank   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Splice   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value 12-438 in the Circuit Number field

Substation   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value Maple in the Substation Name field

Sub Breaker   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Support Structure [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Switch   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Switch Gear   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Terminator   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value 12-438 in the Circuit Number field

Transformer Bank [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field and the Type field as ThreePhaseOverhead and also
as ThreePhaseUnderground to test the Pad Number Field

Voltage Regulator [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Casing   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value Hammond in the LOA field

CP Rectifier   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field (Note: There are no records with install date
populated)

Dead End   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value 1 in the System ID field

Drip Pot   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Fitting   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Insulated Coupling[PASS / FAIL] Executed by _____ Reason for failure _____
Use the value 1300 in the System ID field

Main (Dist)   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Main (Trans)   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Pipeline Marker   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Regulator Station [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Take Station   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Valve   [PASS / FAIL] Executed by _____ Reason for failure _____
Use the value LaPorte in the LOA field

Appendix E

AEDR Field Browser Implementation Plan

AEDR Field Browser Implementation Plan

ID		Task Name	Start	Finish	
1	✓	**AEDR Field Browser Implementation Plan**	**Thu 8/31/06**	**Thu 4/26/07**	
2	✓	**User Acceptance Testing**	**Thu 8/31/06**	**Fri 10/27/06**	
3	✓	Obtain user acceptance testing signoff	Thu 10/26/06	Fri 10/27/06	
4	✓	Train users on new Field Browser for acceptance testing	Thu 8/31/06	Thu 8/31/06	
5	✓	Finalize configuration including user changes	Fri 9/8/06	Fri 9/8/06	
6	✓	**Set-up & Training**	**Mon 9/11/06**	**Mon 9/11/06**	
7	✓	Provide Trainer with 2 laptops, 1 FB and 1 standard build	Mon 9/11/06	Mon 9/11/06	
8	✓	Train the Trainer on new Field Browser	Mon 9/11/06	Mon 9/11/06	
9	✓	**Build Field Browser Laptops**	**Thu 9/7/06**	**Thu 4/26/07**	
10	✓	Finalize the component specs and check in to Source Safe	Fri 2/23/07	Thu 4/26/07	
11	✓	Acceptance test the build IT will be using to image all laptops	Thu 9/7/06	Sat 9/9/06	
12	✓	Cut the final data	Fri 9/8/06	Fri 9/8/06	
13	✓	Image all laptops	Mon 9/25/06	Mon 10/9/06	
14	✓	Inventory all laptops as they come in	Mon 10/2/06	Mon 10/9/06	
15	✓	Create laptop management procedure with IT & LOA supervisors	Tue 9/26/06	Thu 12/7/06	
16	✓	**Test the image**	**Tue 9/12/06**	**Fri 11/24/06**	
17	✓	Modify the test plan	Fri 9/15/06	Fri 9/15/06	
18	✓	Create signoff sheets	Fri 9/29/06	Fri 11/24/06	
19	✓	Test the image on all laptops for integrity	Tue 9/12/06	Thu 10/12/06	
20	✓	Provide signoff sheets to Trainer for release of Field Browsers	Fri 9/29/06	Fri 11/24/06	
21	✓	**Engineering standards**	**Tue 9/12/06**	**Wed 9/20/06**	
22	✓	Create .bat for loading standards & any additional files on the laptops	Wed 9/13/06	Thu 9/14/06	
23	✓	Determine if additional information is required, I.e. pole books, etc.	Tue 9/12/06	Tue 9/12/06	
24	✓	Load Engineering Standards	Thu 9/14/06	Wed 9/20/06	
25	✓	**Field Browser manual**	**Mon 9/11/06**	**Wed 11/1/06**	
26	✓	Provide Trainer with current Field Browser manual softcopy	Mon 9/11/06	Mon 9/11/06	
27	✓	Develop the new Field Browser manual	Fri 9/15/06	Thu 9/28/06	
28	✓	Review and approve Field Browser manual	Fri 9/29/06	Fri 9/29/06	
29	✓	Check the new Field Browser manual into Source Safe	Fri 10/13/06	Fri 10/13/06	
30	✓	Print Field Browser manuals - Batch 1 - 100	Mon 10/2/06	Mon 10/2/06	
31	✓	Print Field Browser manuals - Batch 2 - 150	Wed 10/18/06	Wed 10/18/06	
32	✓	Print Field Browser manuals - Batch 3 - 150	Mon 10/30/06	Mon 10/30/06	
33	✓	Print Field Browser manuals - Batch 4 - 150	Wed 11/1/06	Wed 11/1/06	
34	✓	Print Field Browser manuals - Batch 5 - 150	Wed 11/1/06	Wed 11/1/06	

AEDR Field Browser Implementation Plan

ID	ℹ	Task Name	Start	Finish	
35	✓	Print Field Browser manuals - Batch 6 - 150	Wed 11/1/06	Wed 11/1/06	
36	✓	**Field Personnel Training**	**Fri 9/15/06**	**Thu 12/7/06**	
37	✓	Identify Field Browser users	Thu 9/21/06	Thu 11/2/06	
38	✓	Verify all LOA supervisors have responded to GIS Manager's e-mail request	Fri 9/15/06	Thu 9/28/06	
39	✓	Document Field Browser users via spreadsheet(s)	Mon 9/25/06	Thu 11/2/06	
40	✓	Provide Trainer with training data	Wed 9/27/06	Thu 9/28/06	
41	✓	Develop the training outline	Thu 9/28/06	Thu 9/28/06	
42	✓	Set up training schedule	Mon 10/2/06	Wed 11/29/06	
43	✓	Contact and coordinate users for training	Mon 10/2/06	Wed 11/29/06	
44	✓	**Conduct the Field training**	**Tue 10/10/06**	**Thu 12/7/06**	
45	✓	Gary/Hammond Crown Point Line (2)	Tue 10/10/06	Tue 10/10/06	
46	✓	Gary/Hammond Crown Point C&M (9)	Tue 10/10/06	Tue 10/10/06	
47	✓	Gary/Hammond Crown Point Line (18)	Thu 10/12/06	Thu 10/12/06	
48	✓	Gary/Hammond Crown Point C&M (10)	Thu 10/12/06	Thu 10/12/06	
49	✓	Gary/Hammond Crown Point Line (23)	Tue 10/17/06	Tue 10/17/06	
50	✓	Gary/Hammond Crown Point C&M (12)	Tue 10/17/06	Tue 10/17/06	
51	✓	Gary/Hammond Crown Point Line (18)	Thu 10/19/06	Thu 10/19/06	
52	✓	Gary/Hammond Crown Point C&M (10)	Thu 10/19/06	Thu 10/19/06	
53	✓	Construction Valpo LaPorte (13)	Mon 10/23/06	Mon 10/23/06	
54	✓	Construction (6)	Mon 10/23/06	Mon 10/23/06	
55	✓	Construction Valpo Gary (28)	Thu 10/26/06	Thu 10/26/06	
56	✓	Construction Gary (4)	Thu 10/26/06	Thu 10/26/06	
57	✓	Construction LaPorte (8)	Mon 10/30/06	Mon 10/30/06	
58	✓	Construction Monticello LaPorte (10)	Mon 10/30/06	Mon 10/30/06	
59	✓	Construction LaPorte Valpo (16)	Thu 11/2/06	Thu 11/2/06	
60	✓	Construction LaPorte (18)	Thu 11/2/06	Thu 11/2/06	
61	✓	Construction Plymouth (15)	Mon 11/6/06	Mon 11/6/06	
62	✓	Construction Plymouth (6)	Mon 11/6/06	Mon 11/6/06	
63	✓	Goshen (13)	Tue 11/7/06	Tue 11/7/06	
64	✓	Construction Goshen Plymouth (16)	Thu 11/9/06	Thu 11/9/06	
65	✓	Construction Plymouth (1)	Thu 11/9/06	Thu 11/9/06	
66	✓	Construction Plymouth (10)	Mon 11/13/06	Mon 11/13/06	
67	✓	Plymouth LaPorte (2)	Mon 11/13/06	Mon 11/13/06	
68	✓	Plymouth South Bend Peru (4)	Thu 11/16/06	Thu 11/16/06	

AEDR Field Browser Implementation Plan

ID	ℹ	Task Name	Start	Finish	
69	✓	Construction Field Operations (2)	Thu 11/16/06	Thu 11/16/06	
70	✓	Peru Corrosion-Plymouth GM&T-South Bend Eng-Valpo (5)	Mon 11/20/06	Mon 11/20/06	
71	✓	GM&T-South Bend C&M-South Bend (3)	Mon 11/20/06	Mon 11/20/06	
72	✓	Engineering-Valpo & LaPorte (3)	Mon 11/27/06	Mon 11/27/06	
73	✓	Engineering-Valpo (1)	Mon 11/27/06	Mon 11/27/06	
74	✓	Engineering-Valpo GM&T South Bend (4)	Thu 11/30/06	Thu 11/30/06	
75	✓	GM&T-South Bend Eng-Valpo (5)	Thu 11/30/06	Thu 11/30/06	
76	✓	GM&T-South Bend Eng-LaPorte (3)	Thu 12/7/06	Thu 12/7/06	
77	✓	Engineering- Gary & LaPorte (2)	Thu 12/7/06	Thu 12/7/06	
78	✓	**Rollout Laptops**	**Fri 9/22/06**	**Fri 12/15/06**	
79	✓	Create procedures for monthly updates	Mon 10/2/06	Tue 11/28/06	
80	✓	Create .exe file	Wed 9/27/06	Fri 9/29/06	
81	✓	Procure DC power source	Fri 9/22/06	Fri 9/29/06	
82	✓	Procure remaining AC power sources from IT	Fri 10/27/06	Fri 10/27/06	
83	✓	Procure 5 replacement laptop batteries for faulty batteries found during testing	Mon 10/2/06	Mon 10/16/06	
84	✓	Obtain signature from LOA supervisors upon release of laptops	Thu 12/7/06	Thu 12/7/06	
85	✓	Log responsible supervisor on electronic signoff sheet	Fri 12/15/06	Fri 12/15/06	
86	✓	**Field Browser Application Users**	**Thu 10/5/06**	**Thu 3/1/07**	
87	✓	Create installation procedures for FB application users	Thu 10/5/06	Fri 10/6/06	
88	✓	Set up the training schedule for GM&T	Mon 1/8/07	Mon 1/8/07	
89	✓	Contact and coordinate users for training	Tue 1/9/07	Tue 1/9/07	
90	✓	FB application user training	Thu 11/30/06	Thu 3/1/07	
91	✓	Install Field Browser application on user desktops/laptops	Tue 10/10/06	Thu 2/15/07	
92	✓	Complete the Field Browser application installation user list	Fri 12/29/06	Fri 12/29/06	
93	✓	**Communication Activities**	**Tue 9/12/06**	**Thu 12/21/06**	
94	✓	Contact Training Manager - Reserve training rooms	Tue 9/12/06	Tue 9/12/06	
95	✓	NIPSCO Roundup notification of Field Browser implementation	Fri 12/15/06	Thu 12/21/06	
96	✓	Contact IT - Reserve onsite for laptop movement	Thu 9/14/06	Thu 9/28/06	

Appendix F

AEDR Field Browser Test Plan

FIELD BROWSER HARDWARE-DATA-APPLICATION TEST

Hardware Test

Power On	------------ ----------------	☐
Logon	-----------------	☐
Did 2 Warnings Appear	-----------------	☐
Mouse Pad, Button & Keys*-------------		☐
Did application start on logon ------------		☐
Close the FB	---------------------------	☐

Date ☐

Name ☐

Serial # ☐

IBM # ☐

****Data Test C:\FieldBrowser

Check for 1 Folder	----------------	☐
Check for 7 Files	----------------	☐
Check size (3,821,153,041 bytes) ------		☐

Open Application

Open using Start -> -------------- ☐ >>>>>>>>

Application Test

Expand TOC for any red "!"	----------------------	☐
Place Pointer over buttons for Tool Tips	----------------------	☐
Toggle TOC On\Off	----------------------	☐
Zoom into a scale of 25,000	----------------------	☐
Are ROW visible	----------------------	☐
Turn on Land Anno, scale to 5,000	----------------------	☐
Are StreetNames visible	----------------------	☐
Pan	----------------------	☐
Zoom Fixed Zoom In	----------------------	☐
Zoom Fixed Zoom Out	----------------------	☐
Zoom In	----------------------	☐
Zoom Out	---------------------	☐
Zoom Full Extents	----------------------	☐

*Check that the Touch Pad "Tapping" is disabled

**Check closing the application using both the
File/Exit on the menu bar and the Close button.

***Close the laptop, Suspend Mode should be enabled

****Go to Start button -> Setting -> Control Panel
navigate to C:\FieldBrowser and Right-Click -> Properties

Select Window drop-down -> Magnifier	----------------------	☐
Right-Click Magnifier and change factor	----------------------	☐
Move Magnifier Window	----------------------	☐
Close Magnifier Window	----------------------	☐
Click the Identify Tool	----------------------	☐
Click on a feature and view Data	----------------------	☐
Close Identify Tool	----------------------	☐
Click the Find Tool	----------------------	☐
Click the Layers Drop-Down	----------------------	☐
Do you see the features	----------------------	☐
Close the Find Tool	----------------------	☐
Click the Measure Tool	----------------------	☐
Left-Click for start point, extend and double-c	---------------- -----	☐
Is the Measurement in bottom Left corner	----------------------	☐
Check On Electric and ElectricAnno in TOC	---------------- -----	☐

Only do one "Find" for Electric	Right-Click SupportStructure and select Find	------	☐
	Right-Click Substation and select Find	----------------------	☐
Only search one feature for Electric	Right-Click Switch and select Find	----------------------	☐
	Right-Click Pad and select Find	----------------------	☐
Scale should be set to 1200-2400	Pan around and review the Electric Facilities	------	☐
	Check Off Electric and ElectricAnno in TOC	------	☐
	Check On Gas and GasAnno in TOC	----------------------	☐
Only do one "Find" for Gas	Right-Click RegulatorStation and select Find	------	☐
	Right-Click EmergencyValve and select Find	------	☐
Scale should be set to 1200-2400	Pan around and review the Gas Facilities	----------------------	☐
	Check Off Gas and GasAnno in TOC	----------------------	☐
	Right-Click StreetCenterLineIntersection & select Find	------	☐

Close Applicaton**	--------------	☐ <<<<<<<<<<<<<<<<<<<<<<<<<
Suspend Mode***	--------------	☐
Logon	--------------	☐
Open the Engr Stds	--------------	☐
Maximize window & Close	--------------	☐
Change Time	--------------	☐
Logoff/Power Off	--------------	☐

PASS		☐
FAIL		☐

Appendix G

ArcView Training Power Point Presentation

AEDR ArcView

ArcView Training –

►Introductions
►Getting to Know AEDR
►Navigating the ArcView App
►Break
►Standard Tools
►Advanced Tools

AEDR ArcView

Training Logistics

►4 Hours
►3 Segments – each containing:
- Interactive Lecture
- Demo
- Hands on Experience
►Hands on Time (Break)
►Ask Questions Anytime

AEDR ArcView

Introductions

- ► Skye Perry – SSP Innovations
  - Working on AEDR since May 2004
  - Previously Part of the M&M Team
  - Project Management, Technical Architecture, Development, Documentation, & Training
- ► Participants
  - Name
  - Role & Background
  - Expected Use of AEDR

Getting to Know AEDR

AEDR

- ► Automated Energy Distribution and Reliability system
- ► Uses the latest in GIS, Database, and Development Technologies
- ► Combines Mapping with Asset Management
- ► Replaces AutoCAD/Outfield and EDFS

Getting to Know AEDR

AEDR

► 5½ Main Components
- AEDR Online Help (½)
- SAGE
- Facility Browser
- Field Browser
- GIS - ArcEditor
- GIS – ArcView

Getting to Know AEDR

½ - AEDR Online Help
► Accessed via the Intranet Website

Getting to Know AEDR

3 - Field Browser
► Standalone Mapping for Trucks, Field Users, etc
- No Network Connection
- ArcReader Software   No Licenses
- Limited View of the Data
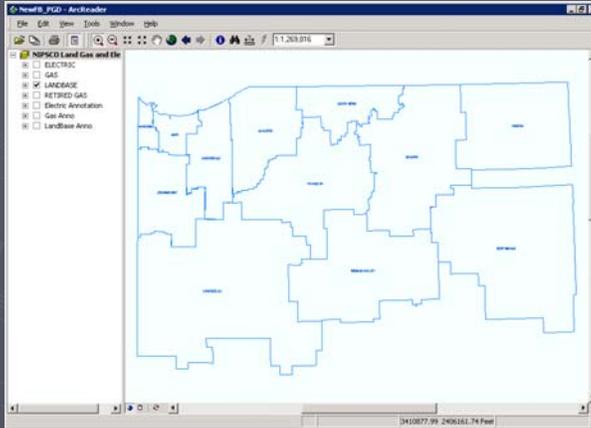
Getting to Know AEDR

4 – GIS ArcEditor   (AE)
► Full Mapping & Data Suite
- Application Published via Citrix
- Single Point of Access to All Data
- Used by Maps & Records   Work Order Editing
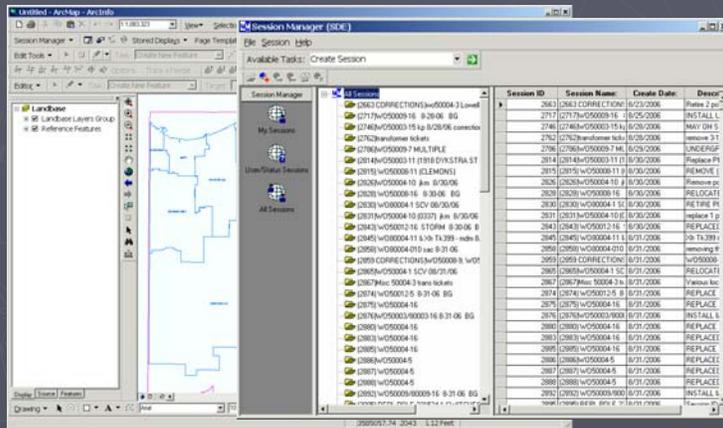
5 – GIS ArcView   (AV)

► Full Mapping & Data Suite
- Application Published via Citrix
- Single Point of Access to All Data   View Only
- Used by Call Screening, ESSO, Scheduling & Assigning Center
- Our Topic of Training Today
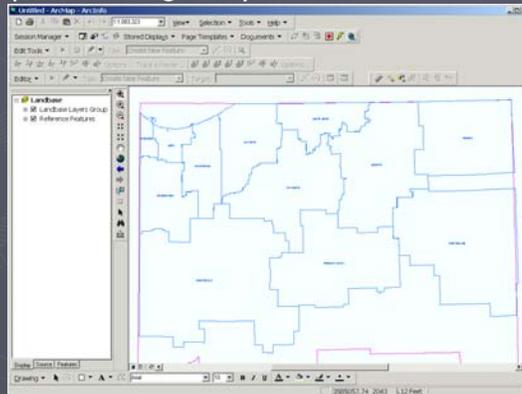
AEDR

► One Database
► 5½ Main Components
- AEDR Online Help (½)
- SAGE
- Facility Browser
- Field Browser
- GIS - ArcEditor
- GIS – ArcView

Questions?

Navigating ArcView

ArcMap – with "View-Only" License

▶ Perform map-based tasks
- Mapping
- Querying
- Analyzing
- Reporting

Navigating ArcView

ArcMap – Available as a Citrix Application

▶ No local installation

▶ Runs remotely on a powerful server

▶ Acts like it is running locally

▶ Applications available anywhere on the intranet
- ArcView for ArcMap
- Access via Intranet
- Click on AV_ArcMap,
- Or, right-click,
    'Save Target As' to your desktop
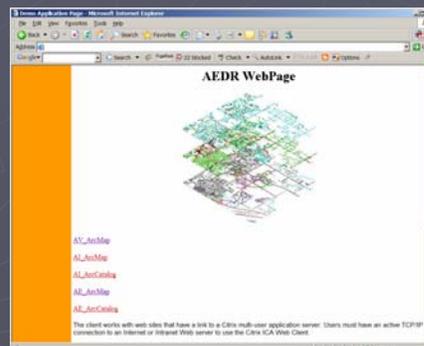
Navigating ArcView

Launch AV_ArcMap
► Log in with your Windows Login

► Application Will Load Based on your User Credentials

Navigating ArcView

Launch AV_ArcMap
► ArcMap will load without any data

Title bar

Menu bar

Tool bars

Table of
Contents

Display area
(map display)

Status bar
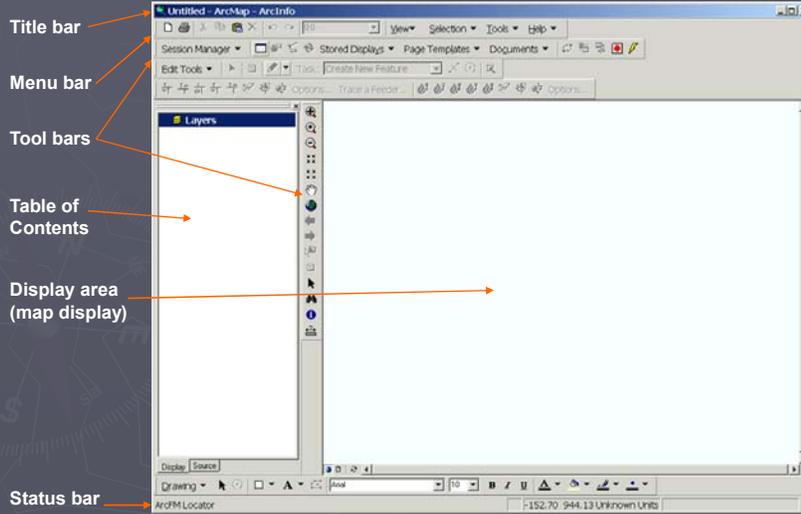
Navigating ArcView

1st Step: Load Data
- ► Use a Stored Display
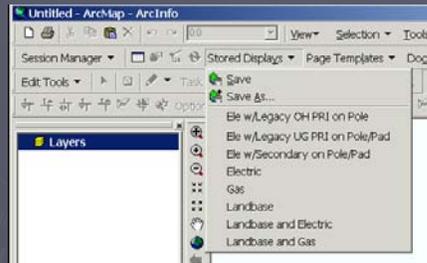
- ► Method to store and retrieve groups of layers
- ► Stores layers & properties
- ► Stored in the geodatabase
- ► Click desired option to load the data

Navigating ArcView

- ► Load Landbase and Electric:
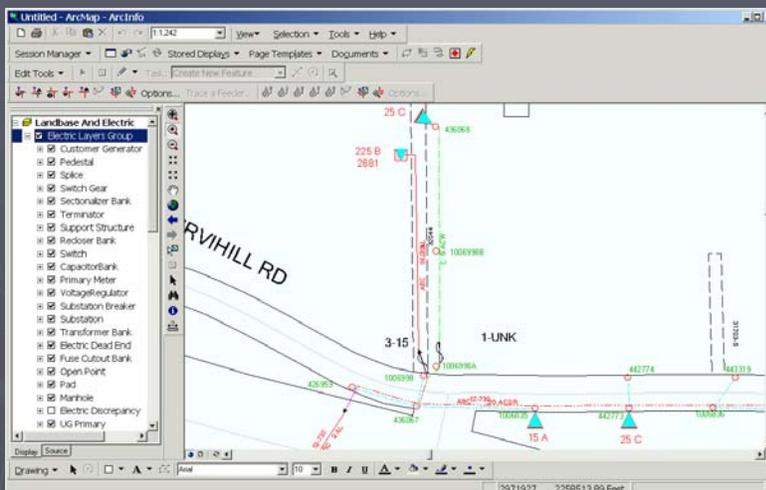
- ► Then Load Landbase and Gas

Navigating ArcView

Landbase and Gas:
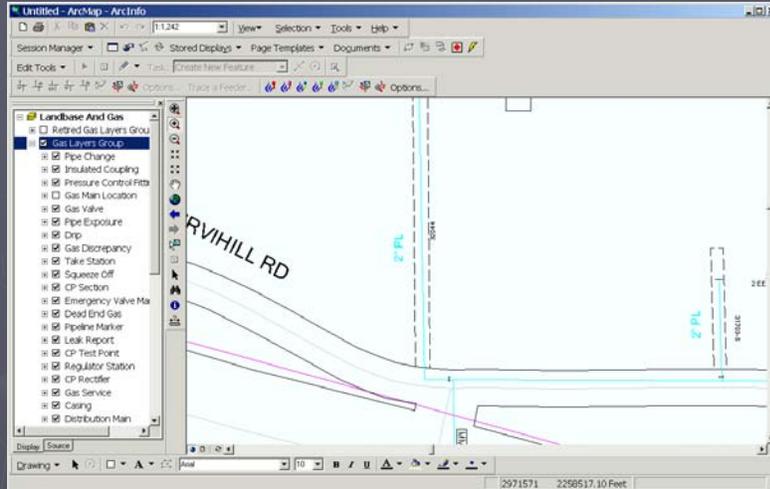
Mapping Area Stays the Same, Content Changes

Navigating ArcView

Within a Stored Display

- Table of Contents
  - Turn Layers On or Off
  - Change Symbology for a Layer
  - Label Features
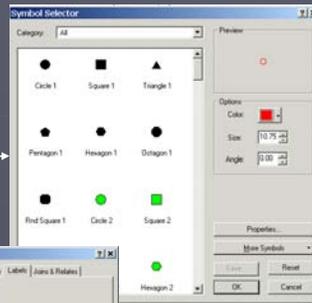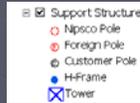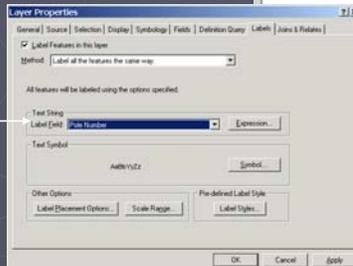
Navigating ArcView

Within a Stored Display

► Create a bookmark to reference a location
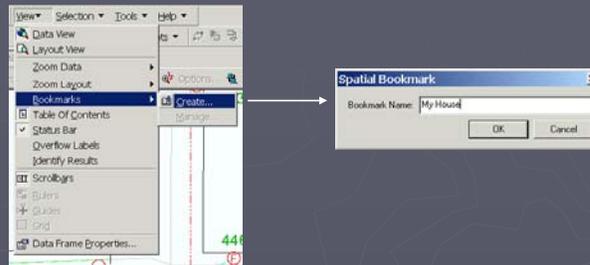
► All of this is temporary within the current session

Unless...

Navigating ArcView

Create a New Stored Display

► All AEDR users can create their own 'User' stored displays
► Accessible only to the current user
► Stored Displays → Save As...
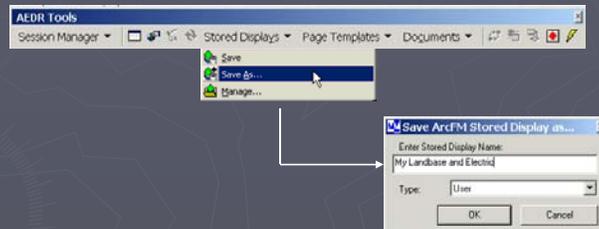
► System stores layers & bookmarks in the database
► User Stored Display will be available whenever you log in again

Navigating ArcView

Core Navigation Tools

- Continuous Pan/Zoom
- Zoom In
- Zoom Out
- Fixed Zoom In
- Fixed Zoom Out
- Pan
- Go to Full Extent (Service Territory)
- Previous View
- Next View
- Select Features
- Clear Feature Selection
- Select Text Elements
- Find
- Measure

Navigating ArcView

Questions?

Demo and Hands On Practice
- ► Get AV_ArcMap.ica
- ► Open ArcMap via Citrix, Login
- ► Load Various Stored Displays
- ► Use Navigation Tools to Browse Data
- ► Edit Display Properties of Layers
  - Symbology
  - Labeling
  - Visibility
- ► Save a User Stored Display

Standard Tools

ESRI Find Address
- ► Enter Address Info
- ► Click Find
- ► Matches are shown below
- ► Right Click for Options
  - ▪ Flash
  - ▪ Zoom To
  - ▪ Pan To
  - ▪ Add Graphic
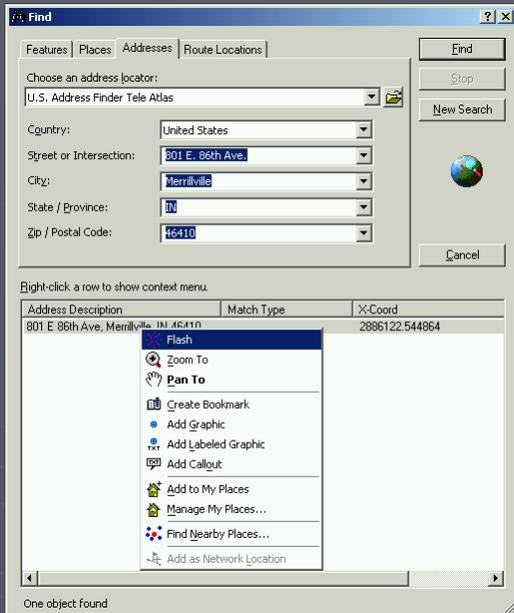
Standard Tools

ArcFM Identify
- ► Click on Any Location on the Map
- ► All Features at that location will be shown in the Identify Window
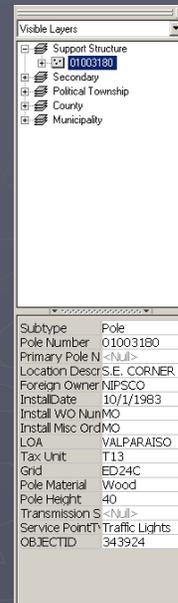
Standard Tools

► Identify Window shows categories of features
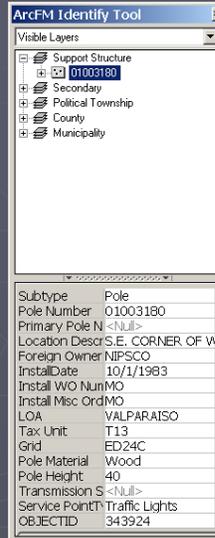
Standard Tools

Identify Tool
► Expand categories to view features
► Click an entry to view attributes
► Right-click an entry for options
  ▪ Zoom To
  ▪ Pan To
  ▪ Highlight
  ▪ Add to Selection
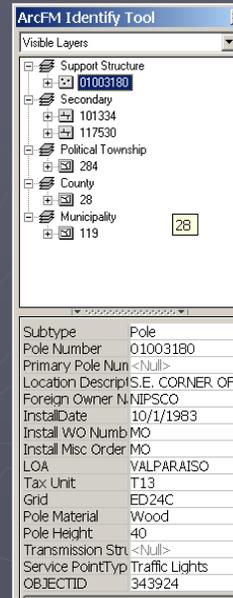
Standard Tools

Identify Tool
- ► Expand features to view relationships
  - ▪ Actual database relationships
  - ▪ Plus sign indicates existence
- ► Expand relationship to view related records
  - ▪ Can be feature or table
- ► Select record to view attributes
- ► Expand record to view relationships
  - ▪ Be aware of reverse relationships
- ► Etc, etc
- ► ObjectID – System ID

ArcFM Identify Tool

Visible Layers

- Support Structure
  - 01003180
    - Annotation
    - Annotation
    - Assembly
      - CLX--100
        - SupportStructure
          - 01003180
    - CapacitorBank
    - CompanyStreetlight
    - CustomerStreetlight
    - Fuse Cutout Bank
    - JointUseAttachment
    - PrimaryMeter
    - RecloserBank
    - SecondaryConductorInfo
    - SectionalizerBank
    - ServiceConductorLoadPo
    - ServiceConductorService

Subtype	Pole
Pole Number	01003180
Primary Pole Nu	<Null>
Location Descri	S.E. CORNER O
Foreign Owner	NIPSCO
InstallDate	10/1/1983
Install WO Num	MO
Install Misc Orde	MO
LOA	VALPARAISO
Tax Unit	T13
Grid	ED24C
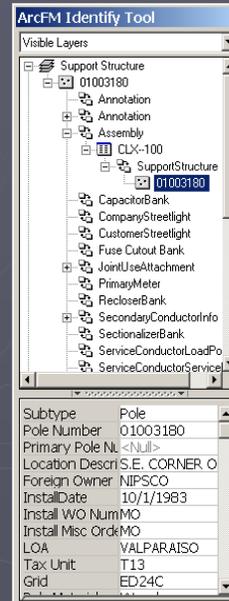
Standard Tools

ArcFM Locator
- ► Allows Querying Against the Database
  - ▪ Features – Visible On Map
    - ► Pole
    - ► Pad
    - ► Regulator Station
    - ► Street Intersection
  - ▪ Tables – Non-graphical Data
    - ► Unit of Property / Asset Management Data
      - ▪ Transformer Unit (Can) Data
      - ▪ Specific Wire Data
      - ▪ Cutout Data within a Fuse

ArcFM Locator

Locator Tool: Attribute Query

Search: Pad

☐ Show all tables
☑ Ignore Subtypes

- Long Pad Number
- Location Description
- Print Id
- Owner Indicator
- INSTALLDATE
- Install WO Number

☐ Auto Zoom
☐ Auto Add to Selection

[Find] [Stop] [Clear]

Standard Tools

ArcFM Locator
- ► Locator field chooses the TYPE of search
  - ArcFM Display Field
  - * Attribute Query (most Common)
  - Object Query
  - * Feeder Manager
  - XY Coordinates

Standard Tools

ArcFM Locator – Attribute Search
- ► Search field chooses WHERE to search
  - Default list includes only Features
  - Check "Show all tables" to include asset tables
  - Asset information is usually related to a Feature
  - Search on the Feature and you can also view asset info
    - ► Ex: Search on a Pole Number to get to the Transformer
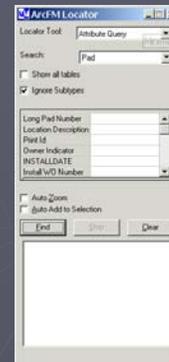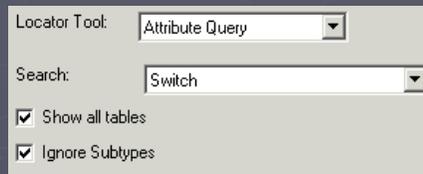
Standard Tools

ArcFM Locator – Attribute Search
- ► Populate known Attributes of the record
  - All attributes are available
  - Only use key fields for a quick search
    - ► Pole/Pad Number
    - ► Switch Id Number
    - ► Company Number
    - ► etc

Switch ID Number	1579
Phase	A
A Phase Normal Position	
B Phase Normal Position	
C Phase Normal Position	
Primary Operating Voltage	

Standard Tools

ArcFM Locator – Attribute Search
- ► Auto Zoom
  - Zooms the map to any found Features
  - Only works for Features (not tables)
- ► Auto Add to Selection
  - Adds any found features to the selection
  - Only works for Features (not tables)

☐ Auto Zoom
☐ Auto Add to Selection

| Find | Stop | Clear |

- ► Click Find to search the database
- ► If search parameters were too broad, search may return too many records. Click Stop to cancel a search.

Standard Tools

ArcFM Locator – Attribute Search
► Results are displayed in the bottom
► Right click the record for options
- Zoom To
- Pan To
- Highlight
- Quick Attribute Viewer
- Add to Selection
- Feeder Manager Translator
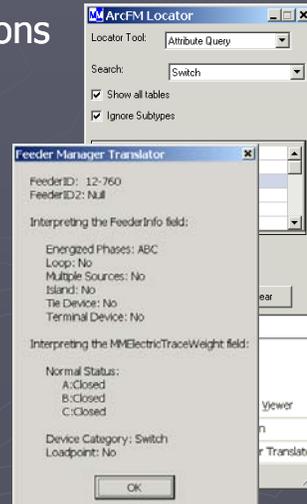
Standard Tools

ArcFM Locator – Feeder Manager Search
► Feeder Manager Search Criteria
► Search for:
- All Feeders
- Multiple-Feed Feeders
- Feeders with Loops
- De-energized Features
- Tie Devices
- Terminal Devices
- Tie and Terminal Devices
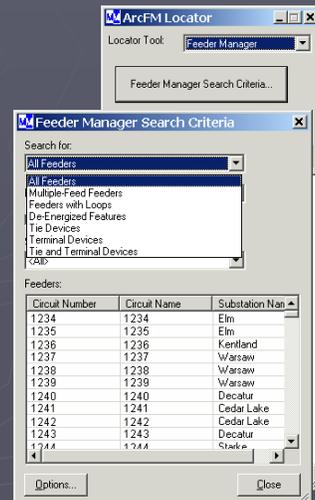
Standard Tools

ArcFM Locator – Feeder Manager Search
- ► Energized Phases
  - Any
  - A, B, C, AB, AC, BC, ABC
  - Any Single-phase
  - Any Two-phase
  - At least A, B, C, AB, AC, BC
- ► Locate Lines Only
- ► Substation
  - Type ahead
  - Selection Filters Feeders
- ► Single Select a Feeder
- ► Multi Select Feeders
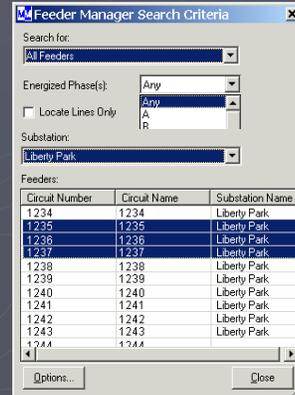
Standard Tools

ArcFM Locator – Feeder Manager Search
- ► Click Close on Search Criteria
- ► Then click Find on the Locator
- ► Results are displayed in categories
- ► Auto Zoom & Add to Selection
- ► Right click the record for options
  - Zoom To
  - Pan To
  - Highlight
  - Quick Attribute Viewer
  - Add to Selection
  - Feeder Manager Translator

Standard Tools

Selecting Features
- ► Select features to use Attribute Viewer
  - ▪ ArcFM Locator Add to Selection
  - ▪ Select Tool
    - ► Click features on map
    - ► Click & Drag box on map to select many features

6 AA

33247

ArcFM Locator

Locator Tool: Attribute Query

Search: Switch

☑ Show all tables
☑ Ignore Subtypes

Switch ID Number 1579
Phase
A Phase Normal Position
B Phase Normal Position
C Phase Normal Position
Primary Operating Voltage

☐ Auto Zoom
☐ Auto Add to Selection

Find   Stop   Clea

⊟ Switch
  ⊞ 4879

Zoom To
Pan To
Highlight
Quick Attribute V
Add to Selection
Feeder Manager

1 object(s) found.
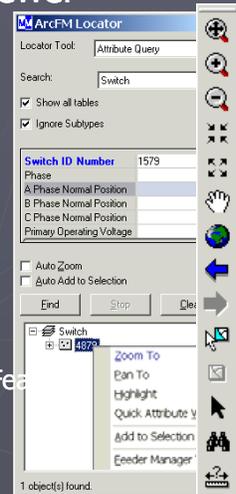
Select Fe

Standard Tools

Selecting Features
- ► Selectable Layers
  - ▪ We can control which layers can be selected
  - ▪ Set by default in the Stored Display
    - ► Landbase and Electric → Only Electric features
    - ► Landbase and Gas → Only Gas features
    - ► Landbase → Only Land features
  - ▪ What if we want to select Land features while in Landbase and Electric?
  - ▪ Selection → Set Selectable Layers

Selection ▾ Tools ▾ Help ▾
- ▤ Select By Location...
- ▥ Select By Graphics
- ▦ Zoom To Selected Features
- ▧ Select by Feeder
- Σ Statistics...
- Set Selectable Layers...
- ▨ Clear Selected Features
- Interactive Selection Method ▸
- Options...
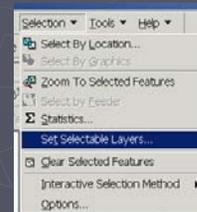
Standard Tools

Selecting Features
- ► Set Selectable Layers
  - List contains all layers from map
  - Leave Anno Un-checked
  - Add/Remove additional layers
  - Helpful in congested areas to only have one layer selectable
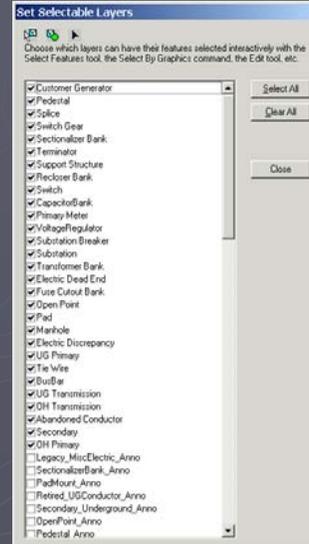
Standard Tools

Attribute Viewer
- ► Displays attributes of selected features

Attribute Viewer

- ► Traverse database/business relationships
- ► View related tables
- ► Locate selected features on map

Standard Tools

Attribute Viewer

► Select features on map

► Attribute viewer shows categories of features
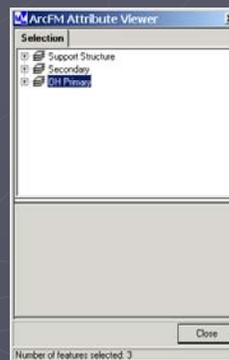
Standard Tools

Attribute Viewer

► Expand categories to view features
► Click an entry to view attributes
► Right-click an entry for options
  - Zoom To
  - Pan To
  - Highlight
  - Quick Attribute Viewer
  - Remove from Selection
  - Remove All from Selection

Standard Tools

Attribute Viewer
- ► Expand features to view relationships
  - Actual database relationships
  - Plus sign indicates existence
- ► Expand relationship to view related records
  - Can be feature or table
- ► Select record to view attributes
- ► Expand record to view relationships
  - Be aware of reverse relationships
- ► Etc, etc
- ► ObjectID – System ID
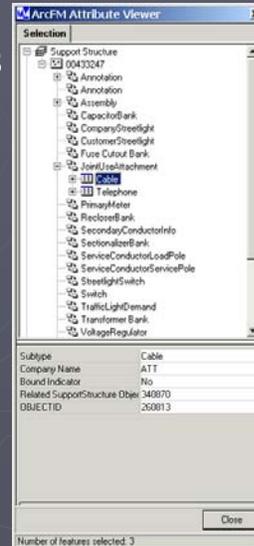
Standard Tools

Questions?

Demo and Hands On Practice
- ► ESRI Find Address
- ► ArcFM Identify
- ► ArcFM Locator
  - Find street intersection
  - Find a pole
- ► Add to selection from locator
- ► Select features on map
- ► Attribute Viewer
  - Inspect attributes
  - Inspect relationships
- ► ArcFM Locator
  - Feeder Manager

Advanced Tools

Advanced Tools
- ► Select by Location
- ► Tracing Tools
- ► Reporting

Advanced Tools

Select by Location
- ► Allows user to select features based on their location with respect to other features
- ► Select a feature or set of features as basis for search
  - ▪ Ex. Municipality of East Chicago
  - ▪ Ex. Select all conductor in a feeder
- ► Selection → Select by Location
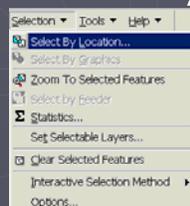
Advanced Tools

Select by Location
- ► I want to:
  - Select features from
  - Add to the currently selected features in
  - Remove from the currently selected features in
  - Select from the currently selected features in
- ► The following layers:
- ► That: "intersect"
- ► The features in this layer:
  - Use selected features
  - Apply a buffer to the features
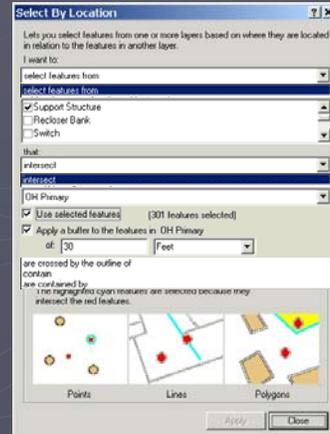
Advanced Tools

Select by Location
- ► Click Apply
  - The resulting features are added to the selection
  - View the features in the Attribute Viewer
  - Create a report
  - Continue further analysis
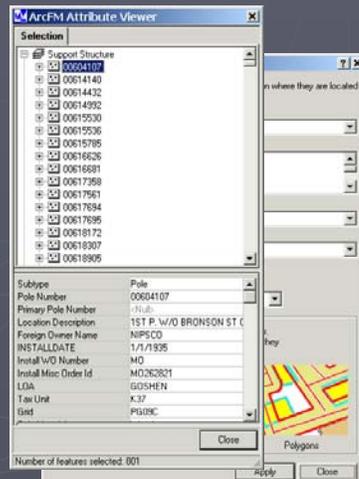
Advanced Tools

Tracing Tools

Electric   Gas

Upstream

Downstream

Distribution

Upstream
Prot. Device

Downstream
Prot. Device

Cathodic
Protection
(Corrosion
Control)

Pressure
System

Squeeze Off

System

Valve Isolation

Advanced Tools

Electric Tracing Tools
► Click on a Trace
► Cursor looks like a flag with a green square underneath
► Click on any type of conductor
► Trace will be returned in a red highlighted color
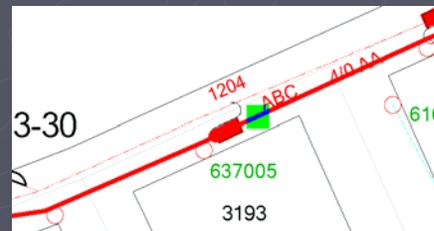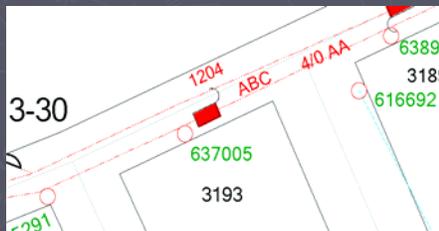
Advanced Tools

Electric Tracing Tools
► Trace will stop at open points, switches, etc

Clear results

Results as Selection

Zoom to Results

Advanced Tools

Electric Tracing Tools

► Electric Options
- Protective Devices
- Phases
- Sources!!!!

Advanced Tools

Electric Tracing Tools

► Electric Options
  ▪ Results Format
  ▪ Results Content
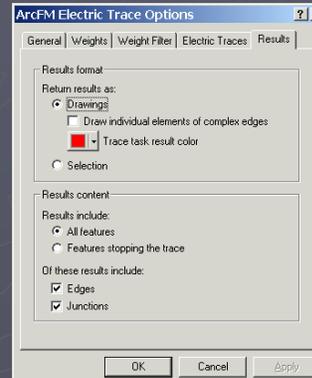
Advanced Tools

Reporting

► ArcMap has a basic reporting engine
► Report on any layer in the map
► Can use a selected set of features
► Call the GIS Department for Advanced Reports
► Click Tools → Reports → Create Report to launch the Report Engine

Advanced Tools

Reporting

► Choose the Layer/Table to report on
► Choose the Fields to report on
► If features are selected on map…
► Otherwise all features
► Grouping
► Sorting
► Summary (numeric fields)
► Display
► Save as *.rdf
► Generate Report
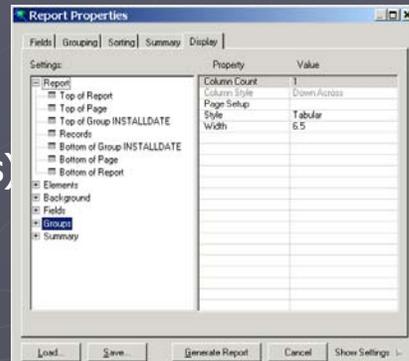
Advanced Tools

Reporting

Pole Number	INSTALLDATE	Pole Height
1/1/1939		
00417406	1/1/1939	35
00417404	1/1/1939	35
1/1/1945		
00422843	1/1/1945	30
1/1/1946		
01005625	1/1/1946	50
01005543	1/1/1946	50
00423687	1/1/1946	50
00423688	1/1/1946	50
1/1/1950		
00426859	1/1/1950	35
1/1/1956		
00431181	1/1/1956	35
00449899	1/1/1956	35
00431183	1/1/1956	40
00431180	1/1/1956	50
1/1/1958		
00433022	1/1/1958	35
00433021	1/1/1958	35
00433025	1/1/1958	35
00433027	1/1/1958	35
00433023	1/1/1958	35
00433026	1/1/1958	35
00432554	1/1/1958	40
00449021	1/1/1958	40
00449158	1/1/1958	40
00432553	1/1/1958	40
00449157	1/1/1958	40

Summary at bottom…

POLEHEIGHTVALUE Average
40

► Print the Report
► Export to PDF to save or email
► Copy the contents to your clipboard & paste into Word/Excel

Advanced Tools

Questions?

Demo and Hands On Practice
- ► Cumulative Practice
  - Use ArcFM Locator to find your favorite substation
  - Set ArcFM Electric Trace Options
  - Trace out a feeder from the substation using the Distribution Trace – lines only
  - Convert results to a selection
  - Use select by location to find any poles within 30 ft of the selected OH Conductor
  - Create a report of the selected poles showing the Pole Number (DistribRefNumber), Install Date, and Pole Height – Group by Install Date, Sort by Pole Height

AEDR ArcView

- ►*ArcView Training –*
  - Check Intranet for ArcView help

  - Call GIS Department for additional support

  - Thanks for Participating!!!

Appendix H

Wind Generation Integration Study

Wind Generation Integration Study

June 2007

Automated Energy Distribution and Reliability System (AEDR)

Subcontract No. NAD-5-33652-01

Under

Prime Contract No. DE-AC36-99GO10337

Foreword

Today more than ever, environmental concerns have taken a prominent seat in the forefront of people's minds. The coupling of this with rapid advancements in the field of wind turbine generation has made this mode of electricity production a realistic option on the commercial scale. It has become more and more possible to produce 'green' electricity at reasonable rates, which translates into profit that may become more significant with the impending deregulation of the energy market.

Wind power, in particular, has shown promise in generation facilities across the globe, most prominently in Northern Europe, with Denmark and Germany spearheading the initiative to improve on the time-tested model of the windmill to fulfill the modern requirements for electrical power. Northern Indiana Public Service Company (NIPSCO) has recognized the potential of such technology, and launched an investigation into the logistical and financial feasibility of erecting wind turbines within the NIPSCO service territory. The operation of wind turbines could lower electrical costs in an unpredictable deregulated market by allowing NIPSCO to produce at least a portion of its required energy at a set rate. As an added benefit, a wind farm could serve as a teaching tool for local University and College engineering students[1]. A wind generation facility would define NIPSCO as having the first utility owned wind farm in Indiana and also offers the opportunity to advance field even further.

As wind generation becomes an increasing part of the total generation mix, the intermittent nature of wind leads to new system management challenges and the possible need for a paradigm change in both expectations of NIPSCO as a participant and/or expectations of independent wind developers into wind farm development.

This study helps us to look ahead and consider an electricity supply system with a different mix of generation. It is not intended to be conclusive, but provides some guidance at this early stage. The investigation will not only involve the collection of wind resource and geographical data, but also wind generator power output data for appropriate turbines. The selection of potential sites are not only based on wind data but also by evaluating a number of logistical concerns. The geographic layout of the particular site, accessibility to the local power grid and zoning regulations set by the municipal government must all be taken into account and deemed acceptable before an area can be identified as a potential wind turbine site. The most promising of these avenues will be presented in an objective fashion, detailing both advantages and drawbacks for every situation.

Feedback should be provided to:

Diane Buche, Principal Investigator   Phone: 219-662-4231
Northern Indiana Public Service Company   Email: dlbuche@nisource.com
20 South Joseph St.
Crown Point, IN 46307

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[1] Indiana Institute of Technology (Indiana Tech), Ft. Wayne; Purdue University, Lafayette; and University of Notre Dame, South Bend; to name a few.

Prepared By
Enspiria Solutions, Inc.
Greg Kneuer, Principal Consultant
www.enspiria.com

Contributors to this study include:

Keith Boyle
National Renewable Energy Laboratory
1617 Cole Blvd., Building 16
Golden, Colorado 80401
Email: Keith_Boyle@nrel.gov

Donna Heimiller
National Renewable Energy Laboratory
1617 Cole Blvd., Building 16
Golden, Colorado 80401
Email: donna_heimiller@nrel.gov

Skye Perry
SSP Innovations, LLC
10541 Wintersweet Court
Parker, Colorado 80134
Phone: 720-838-7042
Email: skye.perry@sspinnovations.com

Diane Buche
Northern Indiana Public Service Company
20 South Joseph St.
Crown Point, IN 46307
Phone: 219-662-4231
Email: dlbuche@nisource.com

Table of Contents

1.   Study Overview

Northern Indiana Public Service Company (NIPSCO), a NiSource Company, engaged Enspiria Solutions (Enspiria)[2] to jointly collaborate with the National Renewable Energy Laboratory (NREL)[3] on this pre-feasibility study for potential wind farm integration within the NIPSCO service territory.

Utilizing NREL's graphical Renewable Planning Model (RPM) application as a starting point, this tool helped identify three (3) wind generation sites located within NIPSCO's service territory as seen in Figure 1. From the modeling perspective, each of these 3 sites offers the feasibility of renewable energy production at a utility scale.
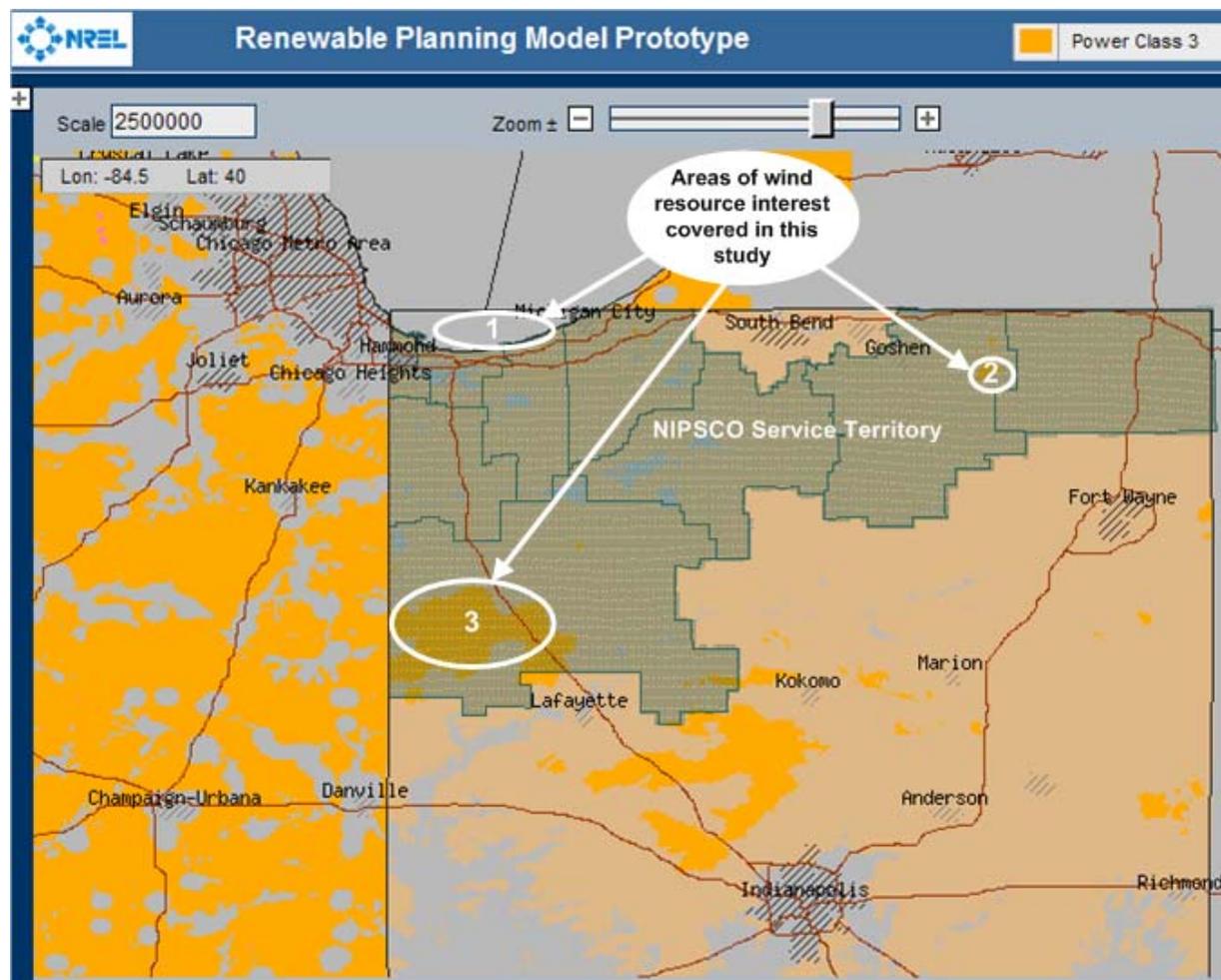
Figure 1. Power Class 3 areas of interest

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[2] Enspiria® Solutions, Inc., is an information technology (IT) consulting services company dedicated to electric, gas, and water utilities, and public sector organizations.
[3] A division of the United States Department of Energy, NREL is the nation's primary laboratory for renewable energy and energy efficiency research and development.

It should be noted that the RPM application links NREL and NIPSCO's Geographic Information Systems (GIS) data to map company facilities and estimated wind generated electric loads that could be potentially integrated into NIPSCO's electric transmission grid. This GIS data was overlaid on top of the NREL's GIS data to identify wind resources, map grid locations, and land usage via satellite images. [An overview of NREL's RPM tool can be found in Appendix 1 of this study.]

The three areas identified below were chosen because each location has enough wind energy to produce electricity 70 – 80% of the time, has desirable terrain to support a 100 MW wind farm (minimum), are non-urban, and each is within reasonable proximity to transmission circuits for connection.

- Area 1 – Lake Michigan offers excellent offshore wind power potential. The water surface area, conservatively about 10 mi^2, is within proximity to two shoreline electric generation stations; NIPSCO's Bailey and Michigan City generation stations.

- Area 2 – A small pocketed Wind Power Class 3 land area (approximately 16 mi^2) located roughly between the towns of Topeka and Emma has numerous small rural farm parcels.

- Area 3 – This is by far the largest contiguous Wind Power Class 3 area (over 350 mi^2) within the NIPSCO service territory. This area incorporates multiple rural towns and vast large farm parcels.

Each of these three areas exhibits both strengths and weakness for wind energy integration. A complete evaluation of each area, including risks and impacts, can be found in Section 3.

1.1   Study Context

It has been estimated by the wind industry and wind resource advocates that Indiana has at least 40,000 MW of wind energy potential. That estimate is more than double the entire generating capacity of Indiana.

NREL recently published a new wind power resource map for the state of Indiana. This resource map shows wind speed estimates at 50 meters (or 50 m) above the ground as illustrated in Figure 1.1.a and models the associate wind power density in W/m² (or Wind per sq. meter)

NREL has also provided their 70 m wind speed (Figure 1.1.b) and 100 m wind speed (Figure 1.1.c) maps of Indiana that further allows us to understand the Indiana wind characteristics and wind power potential at different ground heights. These estimates take into account a number of factors including:

- Wind Power Classes - As a renewable resource, wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). The higher the wind class, the greater the power.

- Energy loss – NREL's estimate assumes that 12% of the power generated is lost.

- Tower height – 80 meters is the current industry model – naturally explaining why 70 m and 100 m wind speed data is important to this study.

- Power potential per square kilometer – It has been published in the industry that 5 MW of turbines can be installed per sq. kilometer (or 0.386 sq. miles) in areas determined to be windy.

- Land area – the study excludes environmentally sensitive land as well as urban areas, airports, wetlands, etc.

The highest onshore wind resources in Indiana are found across the northern half of the state. Class 3 areas are located across the north-central region of Indiana with the largest contiguous area being northwest of Lafayette and northwest of Indianapolis. Other Class 3 areas are located east of Muncie. Particular locations in the Class 3 areas could also have higher wind power class values at 80 meters than shown on the 50 meter map because of possible high wind shear. Given the advances in technology, a number of locations in the Class 3 areas may be suitable for utility-scale wind development within the NIPSCO service territory. Class 2 areas are marginal and Class 1 areas are unsuitable for wind energy development.

Lake Michigan itself offers better and more consistent wind resources. At 70 meters, lake wind speed ranges from 7.5 meters per second (or m/s) along the shoreline, up to 8.5 m/s less then one-half mile offshore. As such, this offers excellent offshore wind generation capabilities, suitable with advanced wind turbine technology. It should be noted however, that wind resource at a micro level can vary significantly; therefore if this or any other area becomes a viable option, NIPSCO will obtain a detailed professional evaluation each specific area of interest.

Based on these identified wind resources, NIPSCO has twin advantages of predominate onshore and offshore wind. Given this renewable energy resource, it is highly beneficial to understand what contribution wind-generated electricity can make to NIPSCO's future energy needs.
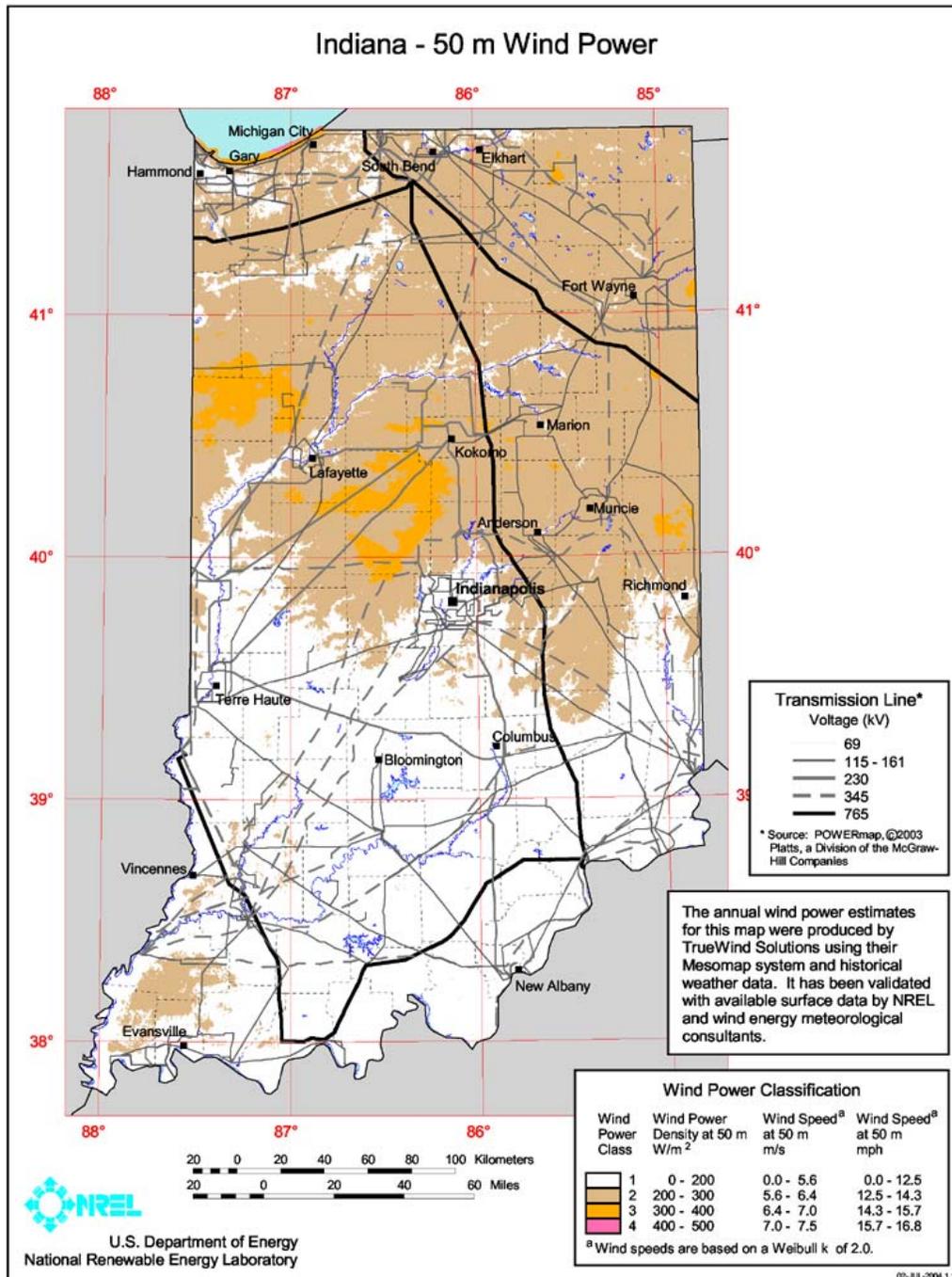
Figure 1.1.a. Indiana 50 Meter Wind Power Map

Figure 1.1.b. Indiana 50 meter wind power map

Indiana - 100 m Wind Speed
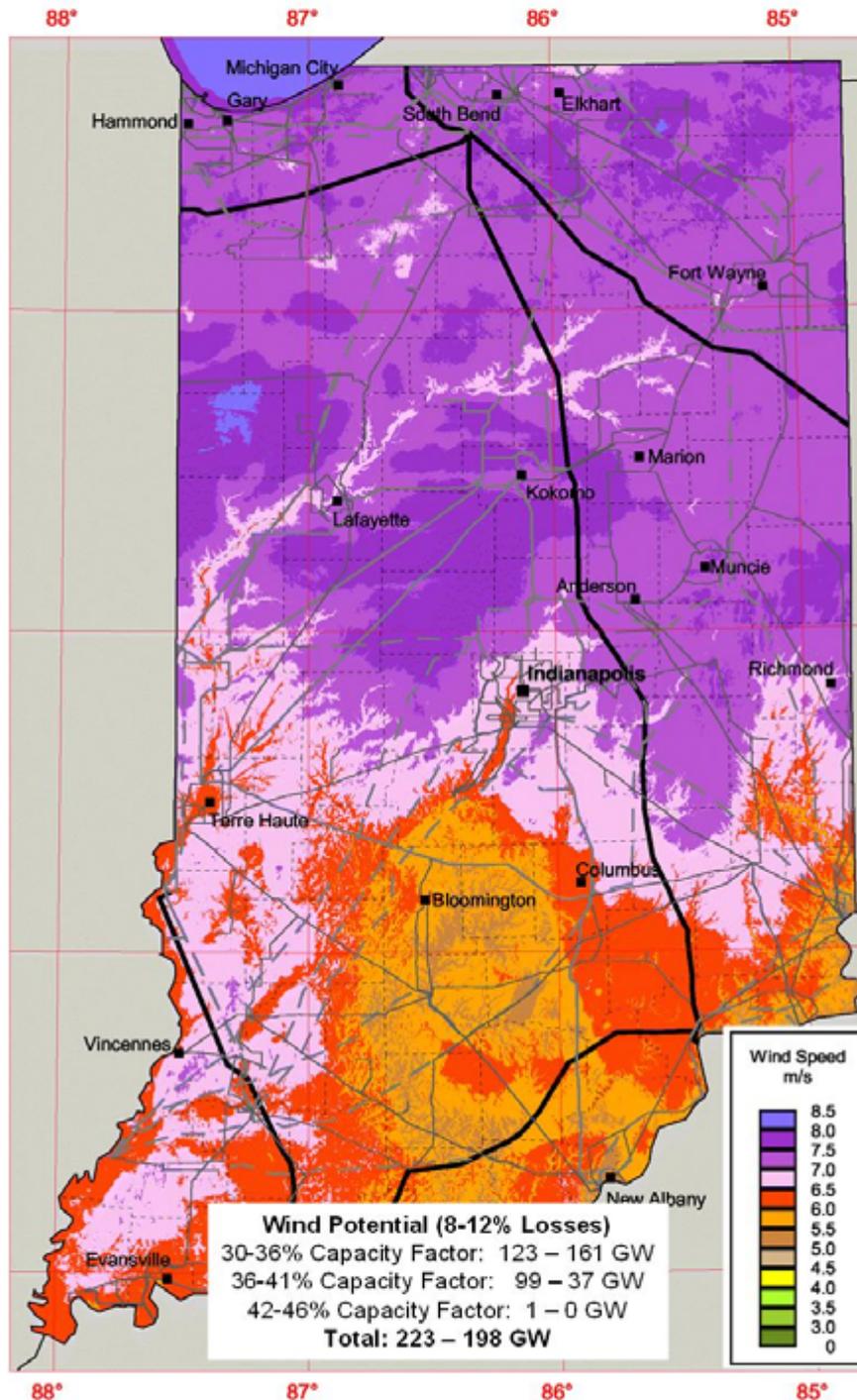
Figure 1.1.c. Indiana 70 meter wind speed map

1.1.1 Supporting Study – "Indiana Energy Group Tall Towers Wind Study"

Since the proposed wind generation does not exist yet, NIPSCO does not have a historical record of wind plant production for the various sites that might be developed for wind generation. However, in 2004, Global Energy Concepts (GEC), contracted by The Indiana Energy Group, conducted in-depth wind study for the state of Indiana. The State of Indiana study known as the "Tall Towers Wind Study" [4] was published in October of 2005. It should be acknowledge that the intention of GEC's wind study was to collect actual wind data at 90 – 100 meters from five towers located within the State of Indiana, including the following two towers that were located within NIPSCO's service territory. These towers sites are known as:

- Goodland – GEC's Site 9003 (Figure 1.1.1.a): This 92 meter tall tower was erected in northwest Indiana, in Newton County, near the town of Goodland, at an elevation of approximately 675 feet above sea level. GEC reports that this "site is flat and clear with no obstructions except for a small transmitter building. The primary land uses farming."
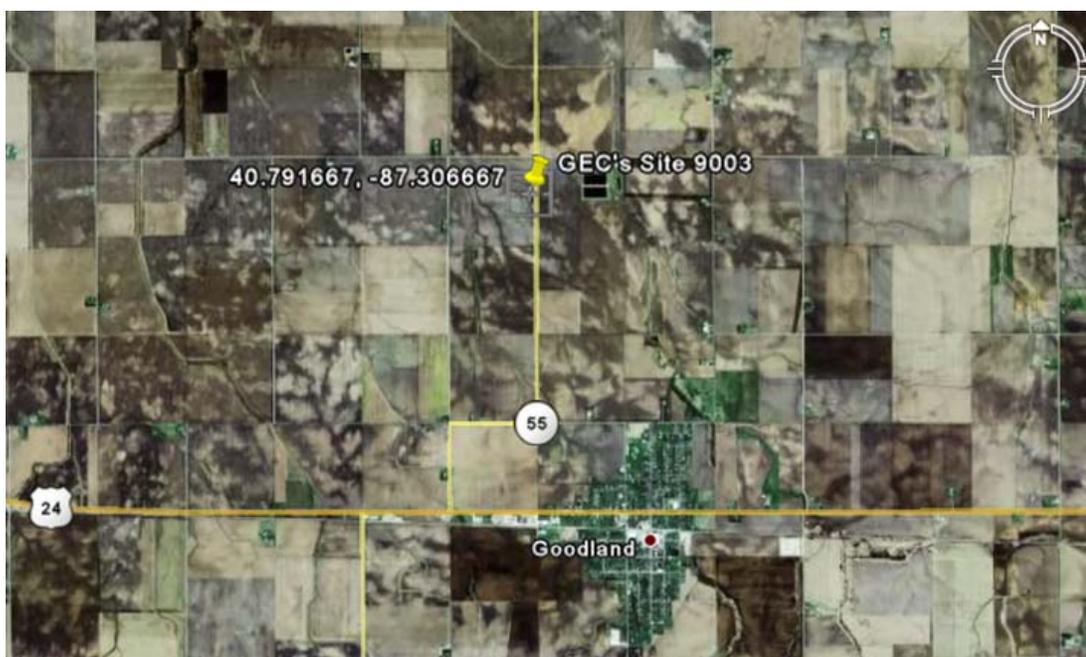
Figure 1.1.1.a. GEC Tall Tower Sites located within NIPSCO service territory

- LaGrange – GEC's Site 9005 (Figure 1.1.1.b): This was a 116 m tower erected in northeast Indiana, in LaGrange County, near the town of LaGrange, about 25 miles east of Elkhart, at an elevation of approximately 1025 feet above sea level. GEC reported that the "site is located on a knoll with numerous 40 to 50 foot trees in all directions. The LaGrange Tower is not as well-exposed as the original tower proposed for the northeast region of the state

---

[4] Reference: Global Energy Concepts' report entitled Indiana Energy Group Tall Towers Wind Study Final Project Report, October 2005. An electronic copy of this report is available in PDF format at this URL: http://www.in.gov/energy/technologies/Indiana%20Final%20Project%20Report.pdf

and the 10 m wind speeds are expected to be obstructed. The tower originally proposed for this area was not available."
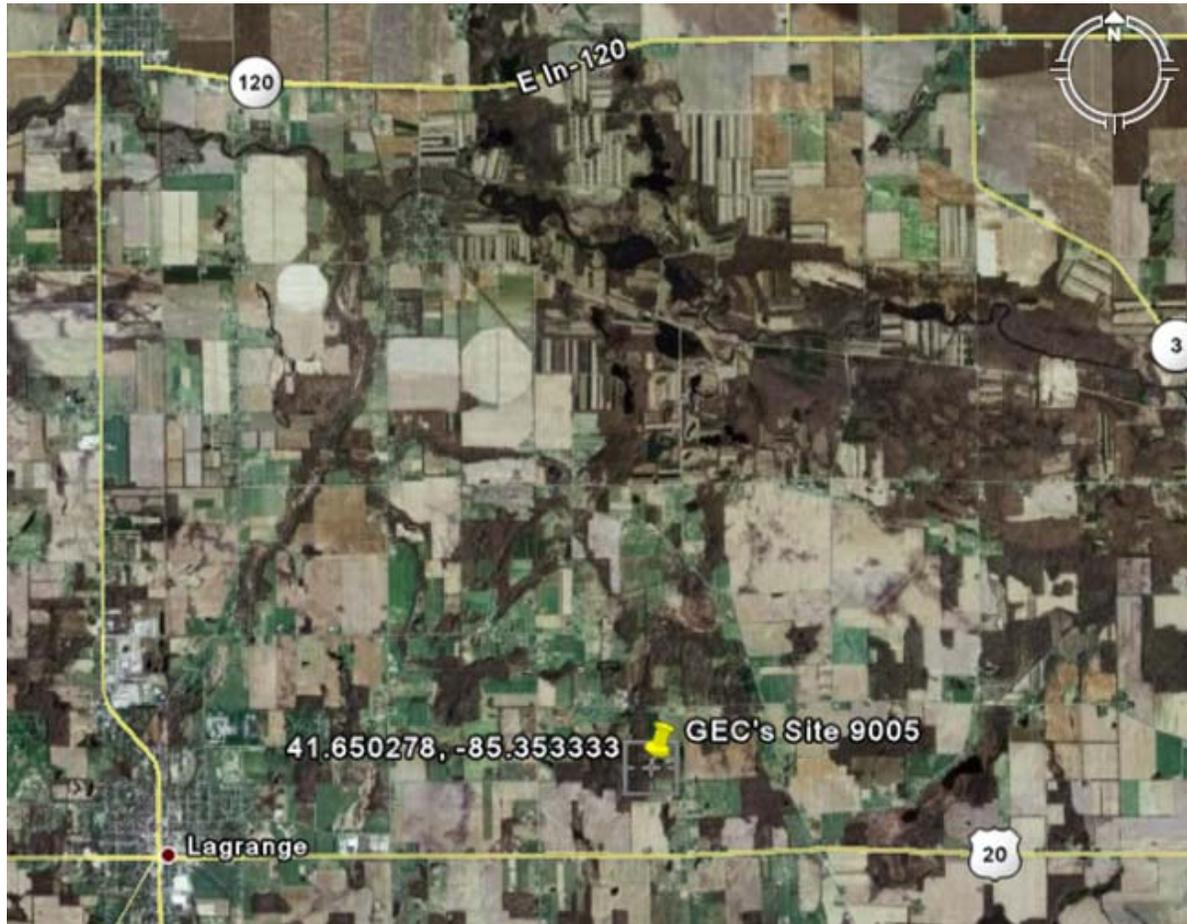
Figure 1.1.1.b. GEC Tall Tower sites located within NIPSCO service territory

The monthly wind averages reported from GEC's study for site 9003 (Goodland) and site 9005 (LaGrange) validate data loaded into NREL's RPM application and support the site recommendations made in this report. Table 1.1.1 shows the monthly average wind speeds for these two sites. The Tall Towers Wind Study also contains diurnal data that also supported wind data utilized within NREL's RPM application.

It should also be recognized, that GEC's site 9003 (Goodland) and site 9005 (LaGrange) are in proximity to the recommended site areas investigated in this study: Area 2 near Topeka, Indiana and Area 3 near Goodland, Indiana.

Table 1.1.1 Monthly average wind speeds

	Site 9003 Goodland			Site 9005 LaGrange		
	90m	49m	10m	99m	49m	10m
April 2004	9.6	8.6	6.7	8.5	6.7	2.2
May	8.6	7.6	6.0	7.0	5.4	1.0
June	6.4	5.5	4.1	6.1	4.6	0.6
July	5.7	4.7	3.3	5.5	4.3	0.6
August	5.6	4.8	3.2	5.4	4.1	0.6
September	6.5	5.4	3.2	5.7	4.3	0.7
October	7.8	6.8	5.1	7.2	5.6	0.8
November	8.0	6.9	5.1	7.1	5.4	1.4
December	8.9	7.9	6.1	8.0	6.2	1.6
January 2005	7.6	6.7	5.4	6.6	5.2	1.7
February	7.3	6.4	4.8	6.5	5.1	1.4
March	7.9	7.0	5.5	6.4	5.3	1.6
Annual	**7.5**	**6.5**	**4.9**	**6.7**	**5.2**	**1.2**

Data Courtesy of GEC – Indiana Tall Towers Wind Study – Final Report

1.2   High-level Plan

NIPSCO's overall plan for NREL's and Enspiria's collaboration on this study is to quantify the volume of wind generated electricity that can be incorporated into NIPSCO's electric grid. With this in mind, the outcomes specifically sought from this initial study are:

- Identification of the pertinent parameters affecting the potential for wind integration

- Development of a methodology that can be used to quantify the potential for the integration of wind generated electricity

- Initial application of this methodology; and

- Identification of further work that would increase understanding of the limits on wind integration.

1.3   Wind Energy Integration Defined

In this study, wind energy integration is defined as "the ability of wind farms to connect to, and operate within NIPSCO's electric grid network in a manner which is compatible with the day to day operations and short-term security of the electricity supply grid as a whole."

Wind energy integration is quantified by its penetration and its market share. Wind energy penetration is defined as the ratio of installed wind capacity in megawatts to peak generation in megawatts, expressed as a percentage value. Penetration is expressed relative to the peak demand of NIPSCO as a whole. Wind energy market share is defined as the total annual wind generation in gigawatt hours (GWh) divided by the total annual generation in GWh, expressed as a percentage. Market share is expressed relative to the total annual generation of NIPSCO as a whole.

1.4   Wind Energy Markets International, U.S., and Indiana

Wind energy is big business. Worldwide, it was worth over $25 billion in 2005.[5] The amount of electricity generated by wind power is growing steadily and predicted to continue its rise. Wind farms now produce 59,000 MW of power worldwide. That's the equivalent of producing enough electricity to power 18 million households.

The countries with the highest total installed capacity are Germany (20,621 MW), Spain (11,650 MW), the USA (11,603 MW), India (6270 MW), and Denmark (3136 MW). 13 countries around the world can now be counted among those with over 1000 MW of wind capacity, with Canada and France reaching this threshold in 2006.

In terms of newly installed capacity in 2006, the USA continued to lead with 2454 MW, followed by Germany (2233 MW), India (1840 MW), Spain (1587 MW), China (1347 MW), and France (810 MW). This development shows the new players such as China and France are gaining ground.

Europe is still leading the market with 48,545 MW of installed capacity at the end of 2006, representing 65% of the global total. In 2006, the European wind capacity grew by 19%, producing approximately 100 GWh of electricity, equal to 3.3% of the total EU electricity consumption in an average wind year.

Asia has experienced the strongest increase in installed capacity outside of Europe, with an addition of 3679 MW, taking the continent over 10,600 MW. In 2006, the continent grew by 53% and accounted for 24% of new installations. The strongest market here remains in India with over 1840 MW of newly installed capacity, which takes its total figure up to 6270 MW.

China more than doubled its total installed capacity by installing 1347 MW of wind energy in 2006, a 70% increase from last year's figure. This brings China up to 2604 MW of capacity, making it the sixth largest market worldwide. The Chinese market was boosted by the country's new Renewable Energy Law, which entered into force on January 1, 2006.

Twenty-two percent of the world's new energy capacity was installed in North America where the annual market increased by a third in 2005, gaining momentum in both the United States and Canada. For the second year running, the US wind energy industry installed nearly 2500 MW, making it the country with the most new wind power.

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[5] The Global Wind Energy Council, 02/17/2006

Canada also had a record year, with the installed capacity more than doubling from 683 MW in 2005 to 1459 MW at the end of 2006.

1.5   Wind Energy in Indiana

Within Indiana, there is currently no utility-owned and operated wind turbine. However, there is the 130 MW Benton County Wind Farm that is under development today by BP Alternative Energy / Orion Energy (Figure 1.5). Once completed, Duke Energy has plans to purchase 100 MW of power from that farm. The Benton County Wind Farm project was approved by the Indiana Utility Regulatory Commission in December 2006 and is expected to be completed in December 2007. Additionally, Indiana Michigan Power is currently looking at projects in Jay and Randolph counties.

Benton County Wind Farm

Owner: Benton County Wind Farm LLC

Location: Benton County, Indiana

Size: 100MW (67 1.5MW GE Turbines)

Acreage: 9,250 acres (63 participating landowners)

Co-Developer: Orion Energy Group, LLC

Construction Start: August 15, 2007

Operational Date: April 15, 2008

Power Buyer: Duke Energy of Indiana, Inc.

Figure 1.5 Benton County Wind Farm

1.6   Technology Trends

A wind turbine generator typically consists of two or three blades connected to a hub to form the rotor assembly. The rotor hub connects to a shaft which turns a generator, usually through the gearbox. The electrical output of the generator is then fed into the grid either directly or through a system of power electronics that converts it to the correct grid frequency and system voltage.

A wind turbine generator has no output at all until the wind speed exceeds its low wind cut-in speed, which is typically between 14.0 – 22 km/h. (or 8.7 – 13.7 mph). Power output then rises until rated output is reached at a wind speed of about 54 km/h (or 33.5 mph), after which power output remains constant until the high wind cut-out speed is reached at about 90 km/h (or 55.9 mph). When the average wind speed exceeds the cut-out speed the wind turbine drops its output to zero to avoid structural damage.

In the early 1980's wind turbine generators were characteristically around 50 kW output capacities with rotor diameters of 20 meters (or approximately 72 feet). In contrast, today's wind turbine generators are sized up to 5 MW and 100 m (or 328 feet) rotor diameters are currently being tested for operation in off-shore wind farms. Rapid growth in this sector has provided manufacturers with incentives for research and development leading to lower costs per megawatt of installed wind turbine generator capacity. This has also led to improvements in the efficiency of conversion of wind energy to electricity and the addition of safety and grid support features which are helping to raise the limits on integration of wind energy in the U.S and around the world.

Specifically, the latest trends in wind turbine generator technology include the addition of technology which allows them to contribute to grid security in many of the same ways as conventional generators, for example:

- Controlling voltage at the output terminals of the wind turbine generator;

- Maintaining a consistent output during faults on the grid where voltage drops suddenly;

- Maintaining output over the nominal 60 Hz frequency at which NIPSCO's grid operates.

The latest generation of wind turbine generators have the ability to connect together to form large wind farms which can be controlled to exhibit most of the attributes of conventional generators, within the limits of how much the wind blows at any particular time.

1.7 Factors Limiting Wind Integration

Given the current trends in wind turbine generator technology noted above, it can be seen that some of the key factors thought to be limiting wind energy integration are already being addressed. However, there are still a variety of issues that are relevant in quantifying the limitations on wind generated electricity integration. These are as follows (each being discussed in further detail below):

1. Frequency management;

2. Short term variation in wind farm output;

3. Generation scheduling;

4. Clustering of wind farms;

5. Development of standards and policy; and

6. Further study/work.

1.7.1 Frequency Management

NIPSCO's electricity supply system normally operates at a more or less constant frequency of 60 Hz. If frequency moves outside normal safe limits then damage may occur to some generators or loads, and hence any event that causes frequency changes must be quickly corrected.

Frequency management takes place at three levels, each with its own requirements and issues. Frequency changes occur when the difference between generation and demand changes, so if demand is constant and generation increases then frequency will increase, and vice versa.

High levels of wind integration potentially cause large, rapid swings in generation which in turn can create rapid frequency changes, possibly to the point of being too much for the regulating station to cope with. As wind integration increases, the performance of the frequency regulating stations will be monitored closely.

Large, rapid and potentially damaging drops in frequency can occur, though infrequently, when a large amount of generation is suddenly lost to the electricity supply system, e.g. a large generating station malfunctions and disconnects from the grid. This possibility requires the system operator (or SO) to ensure that prudent levels of reserve generation are always connected to the grid and able to increase their output instantaneously[6].

How far the frequency falls when generation is lost is highly dependent on the physical characteristics of all generators connected and running at that time. While some of today's wind farms are capable of providing so-called 'instantaneous reserves' while the wind blows, a more important consideration is how individual wind turbine generators assist in slowing the rate at which frequency falls. Not all wind turbine generators are capable of contributing to the restoration of frequency to 60 Hz in the same way that conventional generators do. Therefore, high levels of wind integration will require a detailed understanding of how wind turbine generators influence the frequency after generation is unexpectedly lost.

1.7.2 Short Term Variation in Wind Farm Output

Large swings in wind farm output over periods ranging from minutes to hours require commensurate changes in the output of other NIPSCO generation facilities to ensure that demand is always met. NIPSCO's generation plants must be available and able to make large output changes, either individually or in aggregate. [Note: hydro-electric generating plants are ideally suited to this role.]

Large swings may also increase the frequency of occasions when lines on the grid reach or exceed their safe operating limits, requiring greater efforts on the part NIPSCO, or other measures, to manage the security of the grid.

1.7.3 Generation Scheduling

In addition to very short term uncertainty over wind farm output, there is even greater uncertainty about wind farm output extending from about 3 hours ahead out to the next day. NIPSCO has large coal and gas fired generating stations that can take many hours to 'cold start'. The potential of large scale wind energy to increase the uncertainty around the need to start these stations is considerable. Thus, planning ahead to ensure capacity is available from 'real-time' out to the next day requires the development of suitable methods of forecasting wind farm output to assist in this process.

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[6] Reserves can also be provided by non-essential load that can be disconnected instantaneously.

1.7.4 Clustering of Wind Turbines

Based on wind resource data, when the wind blows it does not blow equally at all locations across the NIPSCO service territory. However, clustering of wind farms within small geographical regions on the grid could tend to increase or decrease their output together, potentially creating large swings in their collective generation.

As previously mentioned in Section 1.5 of this document, a 67 tower cluster (1.5 MW per each tower) known as the Benton County Wind Farm, is currently being developed near Earl Park in Benton County Indiana. The 100 MW cluster is the first phase of two phases. Its unclear today how many towers will be built in Phase II [or when], but the original plans projected 230 MW of electricity to be produced annually. The initial data implies the creation of 100 MW swings in generation output that will cause the SO, Duke Energy of Indiana[7], to review their operating procedures and the capacity of the nearby lines on the grid.

Conversely, if wind farms are geographically dispersed within the NIPSCO service territory, then swings in the combined output of all wind farms would be minimized, but the limits on wind energy integration will potentially be higher than they would be if wind generation develops in one or two clusters.

Additionally, as wind turbine technology continues to develop world-wide, control functions that could limit the magnitude of swings in wind farm output will increasingly become standard issue.

1.7.5 Development of Standards and Policy

Looking ahead, there is a high likelihood that there will be continued investment in wind-generated electricity in the United States – it is already the fastest growing sector of the generation market. In anticipation of this, the adoption or development of appropriate standards for wind farms connecting to the grid is a matter of increasing importance. Progress has already been made in the U.S. in updating the Federal Energy Regulatory Commission (FERC) open access rules. FERC's February 2007 reforms[8] facilitate the use of and access to clean energy resources, such as wind power including:

> TRANSMISSION PRICING REFORMS. The rule reforms the pricing of energy and generator imbalances to require such charges to be related to the cost of correcting the imbalance, to encourage efficient scheduling behavior and to exempt intermittent generators, such as wind power producers, from higher imbalance charges in recognition of the special circumstances presented by such resources.

1.7.6 Further Study and Work

This study has identified a number of areas where additional work will assist in further assessing the issue of integrating wind energy into NIPSCO's electricity supply system.

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[7] Indiana Utility Regulatory Commission, December 6, 2006, approved a request from Benton County Wind Farm LLC to build and operate the first phase (130 MW) of its proposed 230 MW wind power generating facility in Benton County, Indiana. The commission also approved a power purchase agreement requested by Duke Energy to buy 100 MW of power generated from the first phase of the wind farm project.
[8] Docket Numbers: RM05-17 & RM05-25, Order No. 890; Commission adopts Order No. 890, a final rule to reform its landmark 1996 open access rules, Order Nos. 888 & 889

1. Develop a wind speed dataset for use in more detailed and more accurate studies around large scale wind energy.

2. Investigate the impact of large scale wind integration and current trends in wind turbine technology on the ability of NIPSCO's electric supply system to provide sufficient reserve capacity in the event of a sudden drop in system frequency.

3. Develop a consistent set of connection standards for wind farms which anticipate a much larger installed wind energy base.

4. Consider what issues might create barriers to the development of smaller wind farms in many, diverse locations, with a view to obtaining the greatest possible geographical dispersion in the development of wind farms.

5. Develop appropriate wind farm output forecasting methods and related market rules to ensure that the market and NIPSCO as the SO have the information they need to plan ahead to cover the variability of wind farm output on a state and service territory basis.

6. Assess the impact of large scale wind energy integration on peak day electric and natural gas energy supply and delivery.
   a. Electric peak day (summer) – retail and wholesale
   b. Gas peak day (winter) – retail and gas transport

In addition, this study has raised a number of related issues considered worthy of consideration by NIPSCO:

- Determine if an additional reserve service should be scheduled to cover large "wind events" such as storms which could shut down a number of wind farms within a short period (or alternatively, investigate reorganizing the existing continuum of reserve services).

- Assess the potential for more significant deviations in frequency away from 60 Hz with high levels of wind penetration.

- Undertake a study of the power flowing on grid lines around the Benton County Wind Farm cluster to determine how this concentration of wind farms has affected the occurrence of line constraints.

- Undertake a study of the impact of high levels of wind penetration on the ability of the grid to maintain stable operation during and after grid events (e.g. an under frequency event).

- A study to ensure NIPSCO has information about all generation plants that are able to run in order to cover changes in the aggregate output of all wind farms, up to the end of the next day.

2.   Study Introduction and Scope

In February 2007, NIPSCO engaged Enspiria to establish a joint project with NREL to advance NIPSCO's knowledge and understanding of the potential for wind generation that could be incorporated into the NIPSCO electricity supply system. The scope of this study is to summarize the following three high-level points:

> 1. Use NREL's available wind data to locate the most viable locations within the NIPSCO service territory for a potential wind farm (based on amount of wind, location, ownership, etc).

> 2. Use NREL's software tools to select various different wind turbines and the hub height for the turbines, etc and then estimate the annual and monthly averages of energy that could be produced for the specified system.

> 3. Tie the results from #2 above into the feeder load data from the areas surrounding the wind farm so that we can further analyze the effect that the wind-generated energy would have on the demand for NIPSCO-supplied energy.

This study presents an initial assessment of the potential for wind integration, primarily based on information already available from NREL and other sources, and also to identify where there is a need for better information or further investigation.

The outcomes required of the study relate to how much wind generation can be incorporated into NIPSCO's electricity supply system. They include:

- Identification of relevant parameters affecting levels of wind integration on a NIPSCO concentric basis;

- A list of other wind energy generation parameters that are considered either not significant or not relevant to wind integration;

- References to other research on this subject and its applicability to NIPSCO's context;

- Development of a methodology that can be used to assess levels of wind integration – including identifying the limiting parameters and the costs and consequences of exceeding those levels;

- An initial application of this methodology;

- Definition of further discrete studies in order of priority to improve upon the current level of knowledge and understanding of wind integration limits, including the information requirements associated with this study and a program for the additional work that is identified.

The potential for wind energy within parts of the NIPSCO service territory should be considered moderate. The highest wind resources in Indiana are found across the northern half of the state. Class 3 areas are located across the north-central region of Indiana with the largest contiguous area being northwest of Lafayette, Indiana. Particular locations in the Class 3 areas could have higher wind power class values at 80 m than shown on the 50-m map because of possible high wind shear. Given the advances in technology, this study focused on locations in the Class 3 areas that may be suitable for utility-scale wind development.

2.1   NIPSCO Organizational and Energy Load Profile[9]

Northern Indiana Public Service Company (NIPSCO), which is a subsidiary of NiSource Inc., serves the northern third of Indiana with a service territory of about 16,000 square miles; has more than 440,000 residential, commercial and industrial electric customers and nearly 700,000 natural gas customers. NIPSCO is the second largest electric distribution company, and the largest natural gas distribution company in Indiana. NIPSCO owns and operates four coal-fired electric generating stations with net capabilities of 3,179 megawatts, two hydroelectric generating plants with net capabilities of 10 megawatts and four gas-fired combustion turbine generating units with net capabilities of 203 megawatts, for a total system net capability of 3,392 megawatts. It has a peak load of 3,222 MW which was established on June 24, 2005 due to higher than normal temperatures.

The NIPSCO transmission system consists of approximately 495 miles of 345 kV lines, 899 miles of 138 kV lines, 1696 miles of 69 kV transmission lines, and 54 transmission substations. It has 288 (distribution) substations with an aggregate transformer capacity of 23,023,700 kilovolt-amps (kVA). NIPSCO has tie lines that interconnect them with five neighboring control areas of American Electric Power at Indiana Michigan Power, Ameren at Central Illinois Public Service Company, Commonwealth Edison Company, Cinergy at Public Service Indiana, and Michigan Electric Coordinated Systems at Consumers Energy. NIPSCO is also a member of the Midwest Independent Transmission System Operator (MISO) which serves as its reliability coordinator.

NIPSCO's electric distribution system extends into 21 counties and consists of 7,800 circuit miles of overhead and 1,646 cable miles of underground primary distribution lines operating at various voltages from 2,400 to 12,500 volts. Northern Indiana has distribution transformers having an aggregate capacity of 11,638,066 kVA and 447,784 electric watt-hour meters.

2.2   Wind Resource Defined

The wind resource – how fast it blows, how often, and when –plays a significant role in its power generation cost. The power output from a wind turbine rises as a cube of wind speed[10]. In other words, if wind speed doubles, the power output increases eight times. Therefore, higher-speed winds are more easily and inexpensively captured.

Wind speeds are divided into seven classes – with Class 1 being the lowest, and Class 7 being the highest as referenced in Table 2.2. NREL's wind resource assessment evaluated the average wind speeds above sections of land (usually 50 m high), and assigns that area a wind class. Wind turbines operate over a limited range of wind speeds. If the wind is too slow, they won't be able to turn, and if too fast, they shut down to avoid being damaged. Wind speeds in Classes 3 and above are typically needed to economically generate power and in general, sites with a Wind Power Class

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[9] Energy profile data source: *NERC 2004 Control Area Readiness Audit*, by the North American Electric Reliability Council (NERC); Audit Team: Darrell Paitt, Michael Hotsclaw, Edward Stein, Mike Moltane, Robert Koszyk, and Thanh Luong.
[10] The wind speed is extremely important for the amount of energy a wind turbine can convert to electricity: the energy content of the wind varies with the Cube (the third power) of the average wind speed, e.g. if the wind speed is twice as high it contains 2^3 = 2 x 2 x 2 = 8 times as much energy. From high school physics you may be aware that if you double the speed of a car; it takes four times the energy to break it down to a standstill (Essentially this is Newton's second Law of motion).

4 or higher are now preferred for large scale wind plants. Ideally, a wind turbine should be matched to the speed and frequency of the resource to maximize power production.

Table 2.2 Classes of Wind Power Density at Heights of 10m and 50m				
Wind Class	10 m (33 ft)		50 m (164 ft)	
	Wind Power Density (W/m^2)	Speed m/s (mph)	Wind Power Density (W/m^2)	Speed m/s (mph)
1	<100	<4.4 (<9.8)	<200	<5.6 (12.5)
2	100 – 150	4.4 – 5.1 (9.8 – 11.5)	200 – 300	5.6 – 6.4 (12.5 – 14.3)
3	150 – 200	5.1 – 6.0 (11.5 – 12.5)	300 – 400	6.4 – 7.0 (14.3 – 15.7)
4	200 – 250	5.6 – 6.0 (12.5 – 13.4)	400 – 500	7.0 – 7.5 (15.7 – 16.8)
5	250 – 300	6.0 – 6.4 (13.4 – 14.3)	500 – 600	7.5 – 8.0 (16.8 – 17.9)
6	300 – 400	6.4 – 7.0 (14.3 – 15.7)	600 – 800	8.0 – 8.8 (17.9 – 19.7)
7	>400	>7.0 (>15.7)	>800	>8.8 (>19.7)
Source: American Wind Energy Association and NREL				

Since the late 1990s, the Department of Energy (DOE) National Renewable Energy Laboratory (NREL) has been working with state governments to produce and validate high-resolution wind resource potential assessments on a state-by-state basis. This data is being used to gradually replace a less precise national wind resource assessment completed in 1991 by researchers at DOE's Pacific Northwest Laboratory.

Though the wind energy potential is reasonable in parts of the NIPSCO service territory, important issues remain as to how much of that potential can be realized.

Wind energy is unlike any conventional form of large-scale generation, including gas-fired, coal-fired and nuclear thermal generators, or even hydro-electric systems, because wind, as a source of energy cannot be stored.

We can store fuel to use later in thermal generators and we can store water to use later in hydro-electric generation. But wind only ever arrives at a wind farm on a 'use it or lose it' basis.

Furthermore, wind does not always blow steadily. Wind turbine generation output increases with wind speed, as shown in Figure 2.2, but only between limits. The WTG has no output until the wind speed exceeds the low wind cut-in speed which is typically between 4 and 6 m/s (14 – 22 km/h.)
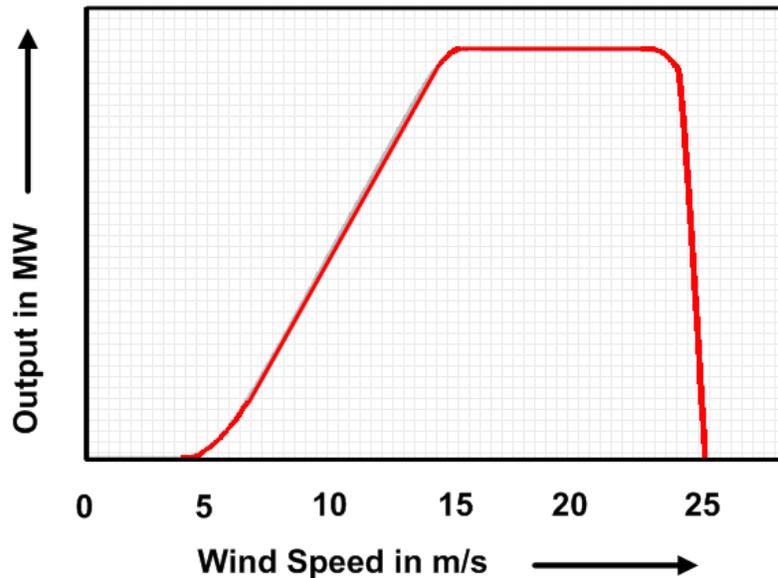
Figure 2.2. Output curve for a typical wind turbine

The wind turbine generator output rises until maximum output is reached[11], after which power output remains constant until the high wind cut-out speed is reached. When the average wind speed exceeds the cut-out speed the wind turbine generator drops its output to zero to avoid structural damage. In Figure 2.2, the high wind cut-out speed is shown as 25 m/s (90 km/h) but it can be higher[12].

The volatile nature of wind farm output poses significant challenges for the electricity supply industry as the installed wind energy base increases. This is particularly so for the wholesale electricity market and for NIPSCO as the SO.

Virtually all generation is offered into the market in a series of prices and quantities on a half-hourly basis. For example, for a particular half hour in the day[13], a generator may offer to generate 100 MW for a low price, a further 100 MW for a higher price and 50 MW more for an even higher price. The SO enters these offers into a computer model of the electricity market each half hour and the model calculates the optimum dispatch of generation. With only a few exceptions, each and every generator is then dispatched at the level specified by the model.

To note, certain electric trading rules have been predicated on the expectation that large-scale generation would be offered into the market and dispatched at a constant output in line with its offers. For example, if a generator offered 100 MW for a particular half-hourly 'trading period' then it could be dispatched at 100 MW and it would be expected to generate as close to 100 MW as reasonably possible for that trading period.

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[11] The power available from a WTG is actually proportional to the cube (third power) of the wind speed.
[12] Data from Windflow Technology, a manufacturer of wind turbine generators, shows a high wind cut-out speed of 30 m/s or 122 km/h.
[13] Each half hour is referred to as a trading period

This key assumption breaks down for wind generation. The best a wind farm can do is to offer its expected output, based on a forecast of wind speed. It probably won't generate at 100 MW, if that is what it is dispatched at, but at a value which is less than or greater than the dispatched amount. So the primary impact of wind generation on the market is its variability, resulting in challenges to well-established processes.

There are wider implications, however, than the impact on the market. NIPSCO's task of ensuring grid security becomes more complex and difficult in the presence of large amounts of wind generation due to the uncertainty surrounding how much a wind farm is going to generate at any particular time, despite its offers in the market.

3.   Study Simulation and Results

As referenced in Section 2, the scope of this study is to summarize the results for following NIPSCO needs:

    I. Locate the most viable locations within the NIPSCO service territory for a potential wind farm

    II. Selection of various different wind turbines and the hub height for the turbines, and then produce annual and monthly averages of energy produced for the specified system. Wind Generators modeled (smallest to largest) include:

Wind Generator	Size (In kW)
Swift 50	1.5
Bergey 1500	1.5
Skystream 3.7	1.8
Generic 3 kW	3
Generic 10 kW	10
Vestas 27	225
Vestas 47	660
GE 1.5 MW	1,500

NOTE: This study list all the wind generators within the RPM application. However, NIPSCO should only be looking at the larger wind generators such as the Vestas 27, the Vestas 47, and the GE 1.5 MW; the other generators listed are considered small wind generators and would not be applicable or practical for this study.

    III. Tie the results from #2 above into the feeder load data from the areas surrounding the wind farm so that NIPSCO can further analyze the effect that the wind-generated energy would have on the demand for NIPSCO-supplied energy.

Wind turbines only occupy a fraction of the land sited, and work in harmony with its established uses. This study recommends rural settings because farming and ranching can continue undisturbed; urban areas have been excluded because wind farms can't fit within the local streetscape.

Benefits

- Minimal land-use

- no emissions

- an energy source that peacefully coexist with its neighbors

Turbine Footprint
Turbines are tall, but they are also relatively slim. Generally each tower base is only 8 m across and each turbine is spaced 250 m apart from one another. Rows of turbines are set one half kilometer apart, leaving a significant amount of space in between each tower. In general, the entire wind farm including towers, substation, and access roads use only about 5% of their allocated land.

The wide spacing of wind turbines ensures the extraction of the maximum energy from the wind and avoids the dirty air of neighboring turbines.

Of course, not all wind farms are set in straight rows, but that doesn't change the fact that many of the activities that occurred on the ground before the wind farm went in can continue undisturbed. Crops can be planted right up to the base of the turbines and harvested with the usual farm machinery, and because the presence of turbines doesn't disturb livestock, they can continue to graze in-and-around the towers.

Wind farms do more than coexist peacefully with agriculture uses of the land. They can also provide an alternative income stream for farmers and ranchers, thus helping farmers and ranchers during the ups and downs of their livelihood.

It should be also recognized that many farm cash crops are government-subsidized. Therefore, any alternative income stream created by a wind farm could be viewed as a "double dip" for a farmer or rancher.

3.1 Area 1

3.1.1 Viable Locations

Area 1 encompasses Lake Michigan in the context of the NIPSCO service territory and the waters to the northern border of the Indiana state line. The water surface area, conservatively about 10 mi^2, is within proximity to two shoreline electric generation stations; NIPSCO's Bailey and Michigan City Generation Stations.
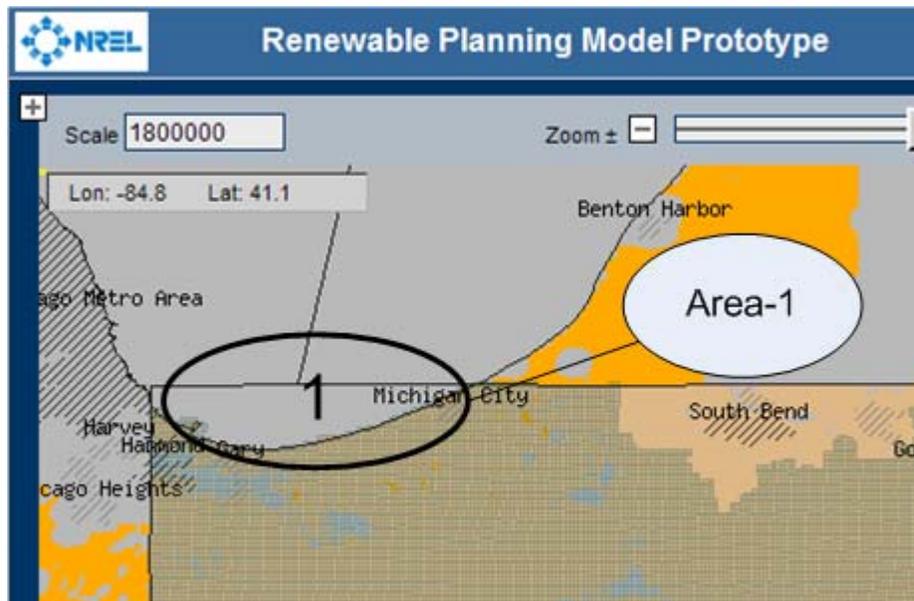
Figure 3.1.1.a. Area 2 Map

As with the land-based wind facilities, offshore facilities are likely to consist of a number of turbines operating independently, but delivering their power to onshore customers through a conduit, typically an undersea cable. In offshore applications, where only two wind directions are likely to predominate, the distance between turbines arranged in a line can be shortened to as little as two to four rotor diameters without creating interference because of turbulence.

Offshore wind energy also has unique challenges associated with it. This includes navigation channels, fishery wildlife, environmental, water sport activities, water currents, extreme weather, National Parks, State Parks, and a host of other associated conditions and concerns.

The following diagram (Figure 3.1.1.b) is United States Coast Guard navigation chart enlarged to focus in on Area 1. This chart clearly shows an open water area that may be suitable for offshore wind power development.
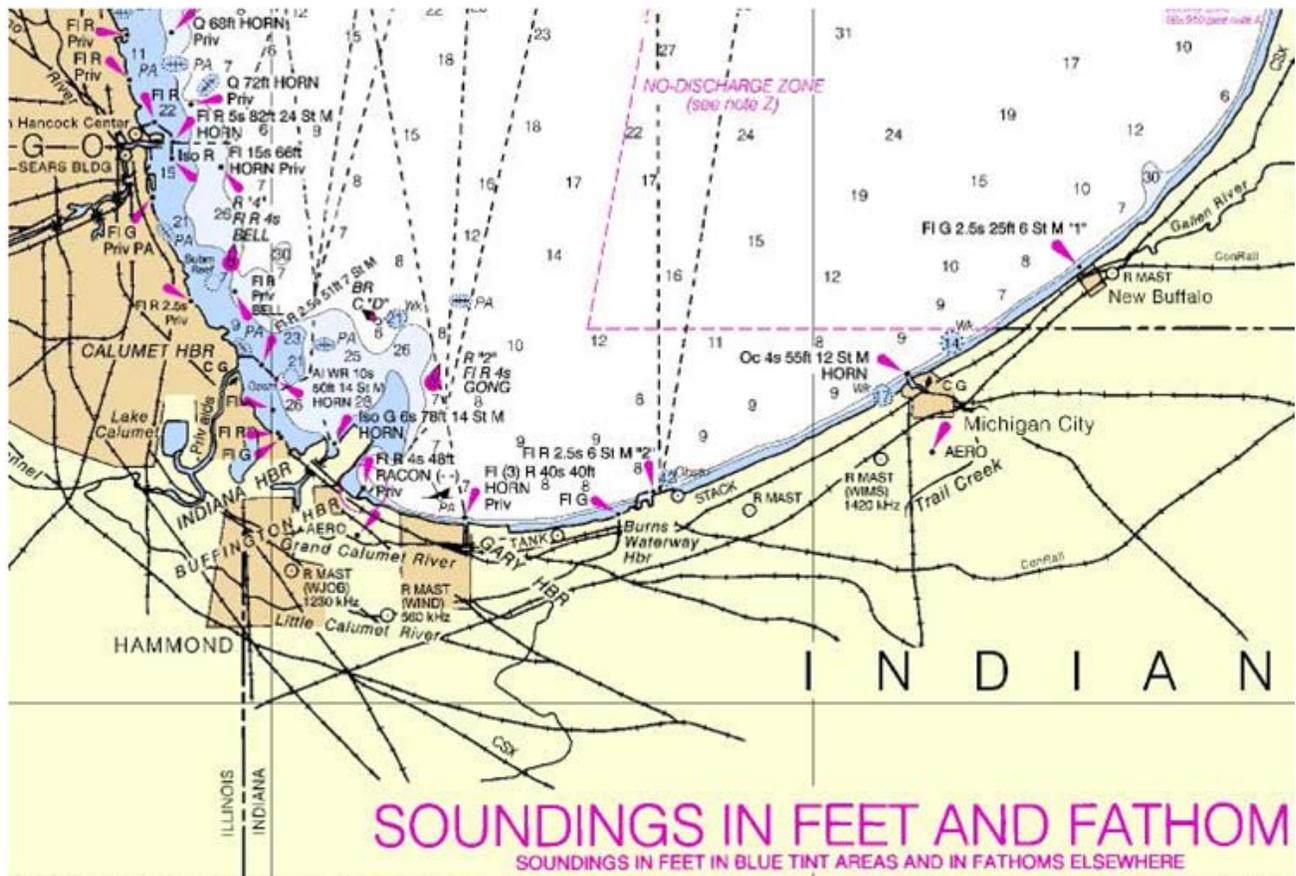
Figure 3.1.1.b. United States Coast Guard – Navigation Chart – Lake Michigan

3.1.2 Various different wind turbines and the hub height

The NREL RPM application was not loaded with Lake Michigan (water) wind resource data specifically contained within the NIPSCO service territory. However, the use of NREL's 70 m and 100 m maps, referenced in Section 1.1, easily identifies Lake Michigan and its Shoreline to be a perfect candidate for offshore wind power development.

Offshore wind turbines are bigger than onshore turbines (to take advantage of the steadier and higher velocity offshore winds and economies of scale). A typical onshore turbine installation today has a tower height of about 60 to 80 m, and blades about 30 to 40 m long; most offshore wind turbines are at the top of this range. Offshore turbines installed today have a power generating capacity of between two and 4 MW, with tower heights greater than 61 m and rotor diameters of 76 to 107 m; turbines up to 5 MW are being tested. Therefore, for the purpose of the study, only the GE 1.5 MW turbine was selected, with hub heights at 50 m, 60 m, and 70 m, and in both Wind Power Class 4 and Class 5 were analyzed using the RPM application. Additionally, it was assumed for study purposes that a number of towers to be simulated would be 65, which equates to an even 100 MW wind generated load.

Wind Class 4 Simulation Results

Wind Estimate

Turbine	GE 1.5MW
Hub Height (meters)	50
Number of Turbines	65

Save System

Simulate Output   164385 MWh

Simulation Results:

Energy: 164385 MWh/yr
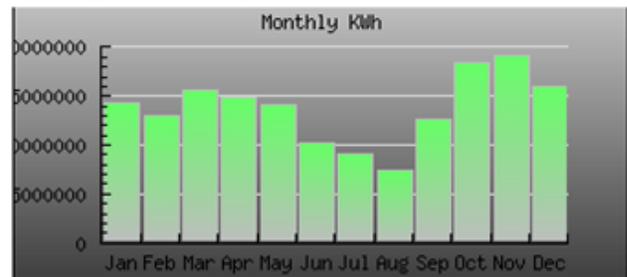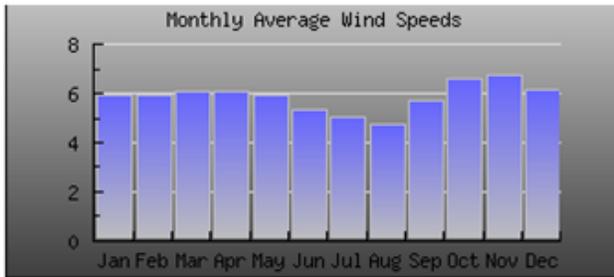
Wind Class 5 Simulation Results

Wind Estimate

Turbine	GE 1.5MW
Hub Height (meters)	50
Number of Turbines	65

Save System

Simulate Output   203905 MWh

Simulation Results:

Energy: 203905 MWh/yr
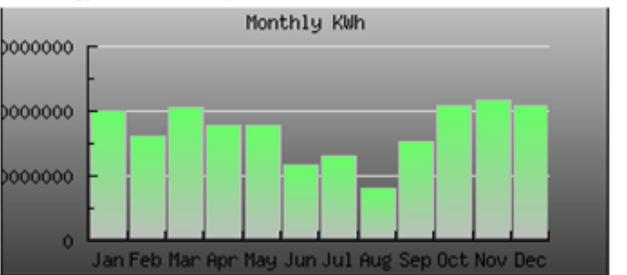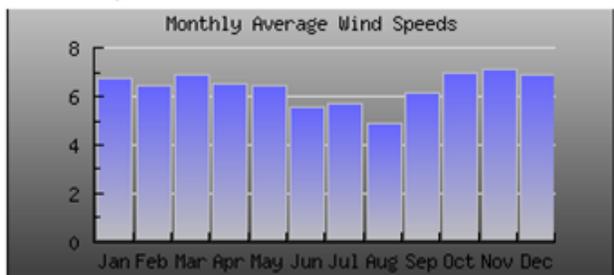
Figure 3.1.2.a. Area 1 – 65 tower, 100 MW, 50 m hub height simulation

Wind Class 4 Simulation Results

Wind Estimate

Turbine	GE 1.5MW
Hub Height (meters)	60
Number of Turbines	65

Save System

Simulate Output   173745 MWh

Simulation Results:

Energy: 173745 MWh/yr
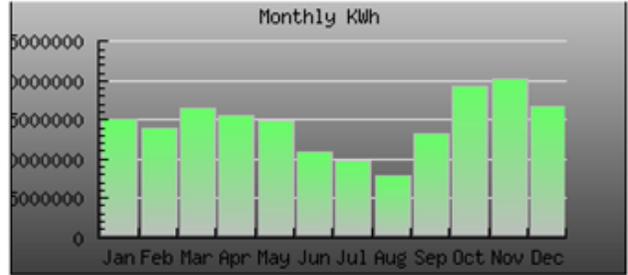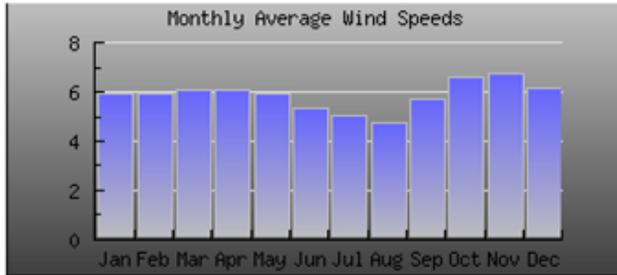
Wind Class 5 Simulation Results

Wind Estimate

Turbine	GE 1.5MW
Hub Height (meters)	60
Number of Turbines	65

Save System

Simulate Output   214305 MWh

Simulation Results:

Energy: 214305 MWh/yr
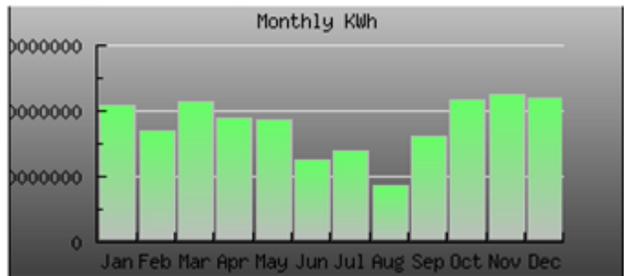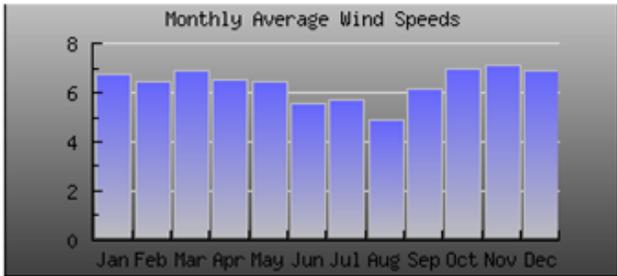
Figure 3.1.2.b. Area 1 – 65 tower, 100 MW, 60 m hub height simulation

Wind Class 4 Simulation Results

Wind Estimate

Turbine   GE 1.5MW

Hub Height (meters)   70

Number of Turbines   65

Save System

Simulate Output   181675 MWh

Simulation Results:

Energy: 181675 MWh/yr

Wind Class 5 Simulation Results

Wind Estimate

Turbine   GE 1.5MW

Hub Height (meters)   70

Number of Turbines   65

Save System

Simulate Output   223080 MWh

Simulation Results:

Energy: 223080 MWh/yr
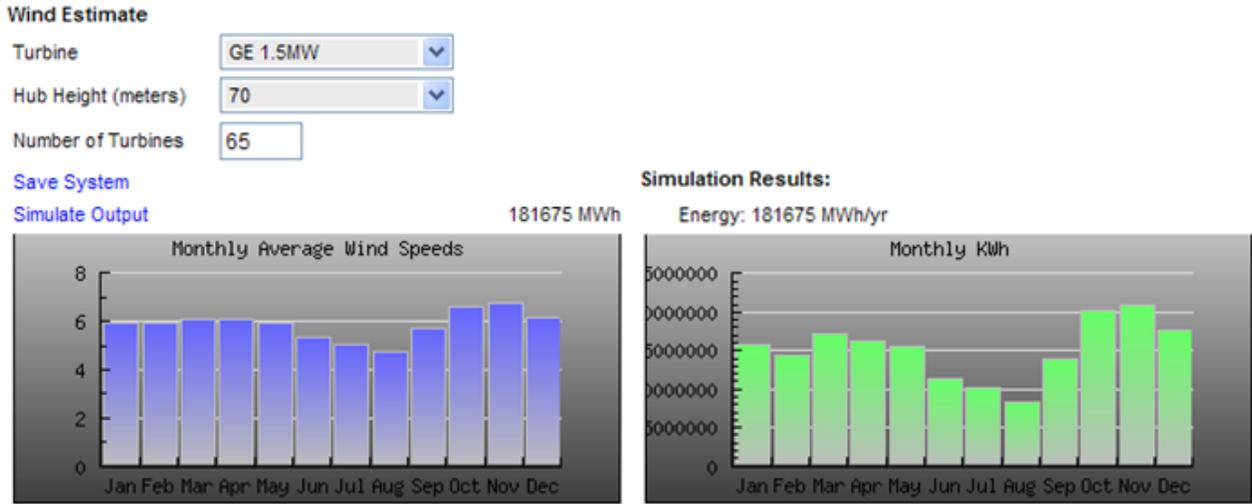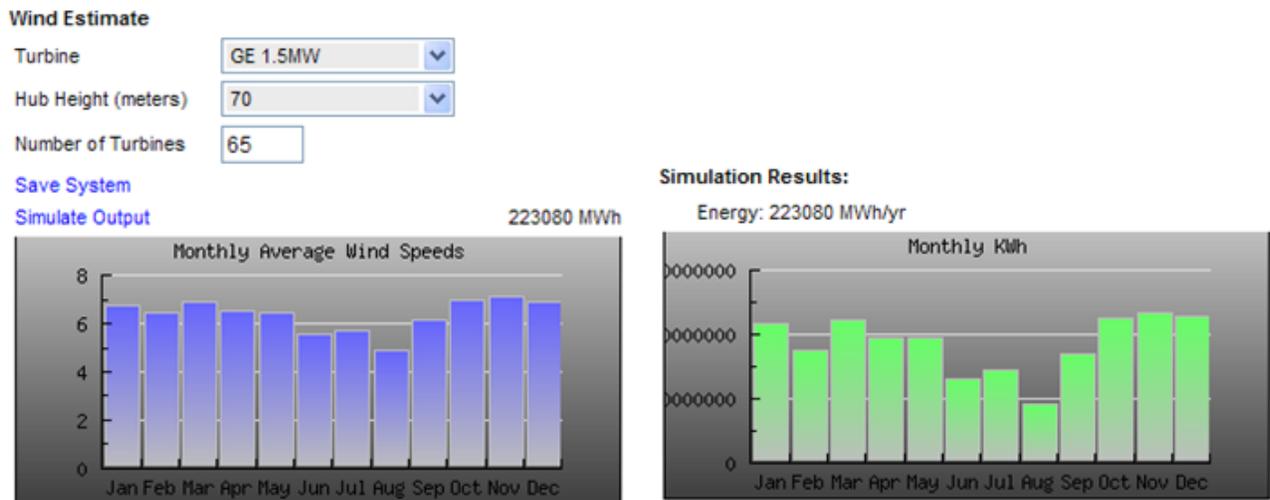
Figure 3.1.2.c. Area 1 – 65 tower, 100 MW, 70 m hub height simulation

3.1.3 Results

The waters of Lake Michigan, just north of the NIPSCO service territory, represent approximately 20 mi.² for potential wind farm development. In rough terms, this water surface area has the wind generation potential of approximately 250 MW. However, this number would have to be downsized based on how Lake Michigan is currently being used for recreation, shipping commerce, and other activities. For this study we have used a total gross load of 100 MW for simulation purposes.

As mentioned in an earlier section, the power output from a wind turbine rises as a cube of wind speed. In other words, if wind speed doubles, the power output increases eight times. Therefore, higher-speed winds are more easily and inexpensively captured. The graphs in Section 3.1.2 clearly indicate this logic both for wind Class-4 and Class-5 simulations.

In each wind class, adding an additional 10 m in height yields approximately a 5 to 9% change in wind generated energy output. However, by going further out into Lake Michigan to capture stronger Class-5 winds, the data indicates an average 22% change in simulated energy results calculated in megawatt hours per year (or MWh/yr). The energy yields for a 100 MW wind farm, with tower and hub heights at a 70 m, would yield 181,675 – 223,080 MWh/yr depending on whether the towers are within a Wind Power Class 4 or Class 5 zone respectively.

It is also interesting to see that the monthly average wind speeds are higher in the winter months and lower in the summer months. Correspondingly, the monthly kilowatt hours/megawatt hours will rise and fall proportionally to the wind speed.

The fluctuations in both summer and winter simulated wind generation would definitely have an affect on NIPSCO system operators. The graphs clearly indicate that using wind power to peak shave summer loads is not a strong option. Conversely, wind generated power in the winter months would be a definite advantage for peak shaving or to augment electric load balancing during power plant maintenance cycles. A native aspect of winter wind power electric peak shaving is that NIPSCO is a dual fuel utility. Natural gas sales could possibly suffer from lost revenues if customers would choose to switch fuel sources and supplement with this new source of electric energy.

A definite advantage of developing offshore wind power in this area is the proximity and availability of various 138 kV overhead transmission lines (multiple circuits) originating at two NIPSCO thermal generation power plants; the Michigan City Generation Station and the Bailly Generation Station. Both generation stations offer good accessibility to 138 kV overhead transmission circuits.

As mentioned earlier, developing offshore wind power facilities may present multiple challenges for NIPSCO. Further studies would be required to understand Lake Michigan's hydrography, coastal morphology, local fauna, fishery wildlife, temperature gradients around underwater cables, submariner noise emission, avian migration paths, and other socio-and environmental economic effects.

3.2 Area 2

3.2.1 Location

For wind turbine development purposes, Area 2 is physically a small (approximately 16 mi²) Wind Power Class 3 footprint area. It is located roughly between the towns of Topeka and Emma, in northeast Indiana, and has numerous small rural and semi-rural farming parcels.

As mentioned in Section 1.1.1, the town of LaGrange had a 116 m weather tower erected to collect wind data for the Indiana Tall Tower Wind Study – reference: GEC's Site 9005 (Section 1.1.1 Figure 1.1.1.b). Even though the town of LaGrange is shown to be in a Wind Power Class 2 area in Figure 3.2.1, the Wind data collected by GEC validates NREL's RPM data.
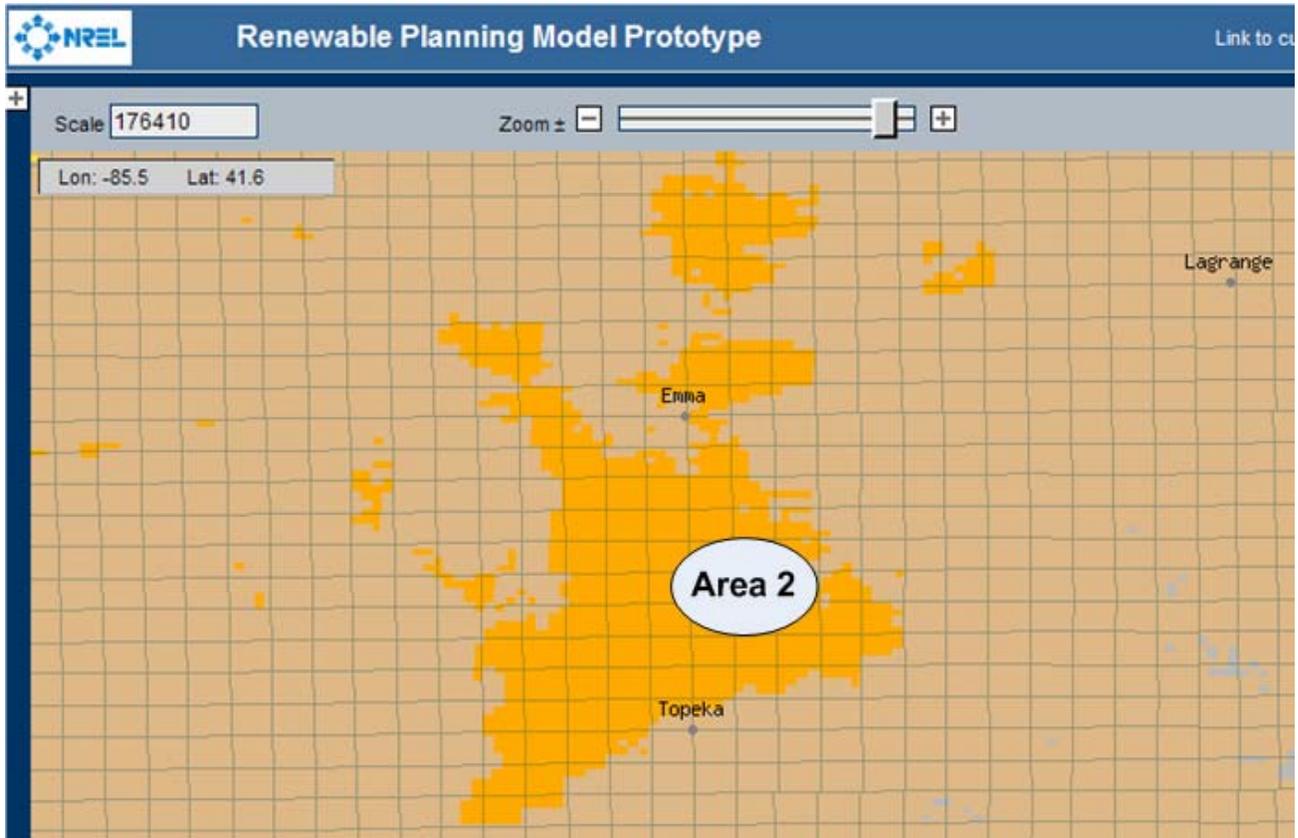
Figure 3.2.1. Area 2 Map

Based on aerial imagery, Area 2 is dotted by numerous small farm and ranch parcels intermixed with low-density residential homes. While this area should not be considered urban, it should be considered semi-rural which will make obtaining land for wind turbines and access roads more difficult. However, the land itself seems to be relatively flat with open farm fields, but trees in some areas will disturb airflow that could cause turbulence with proposed wind generators.

3.2.2 Various different wind turbines and the hub height

Based on nearly the same identical Wind Power Class 3 profiles and wind generator simulations analyzed using NREL's RPM application for all of NIPSCO's minor map grid locations identified in Area 2 and Area 3 that follows, all of the numerous simulations/graphs are illustrated in Appendix 2 to conserve document space.

For illustrative purposes only, Figure 3.2.2.a is a simulation of the GE 1.5 MW turbine, using a 70 m hub height, and 65 towers for a total load of 100 MW.

Wind Power Class 3 Simulation Results

Wind Estimate

Turbine	GE 1.5MW
Hub Height (meters)	70
Number of Turbines	65

Save System

Simulate Output   271245 MWh

Simulation Results:

Energy: 271245 MWh/yr
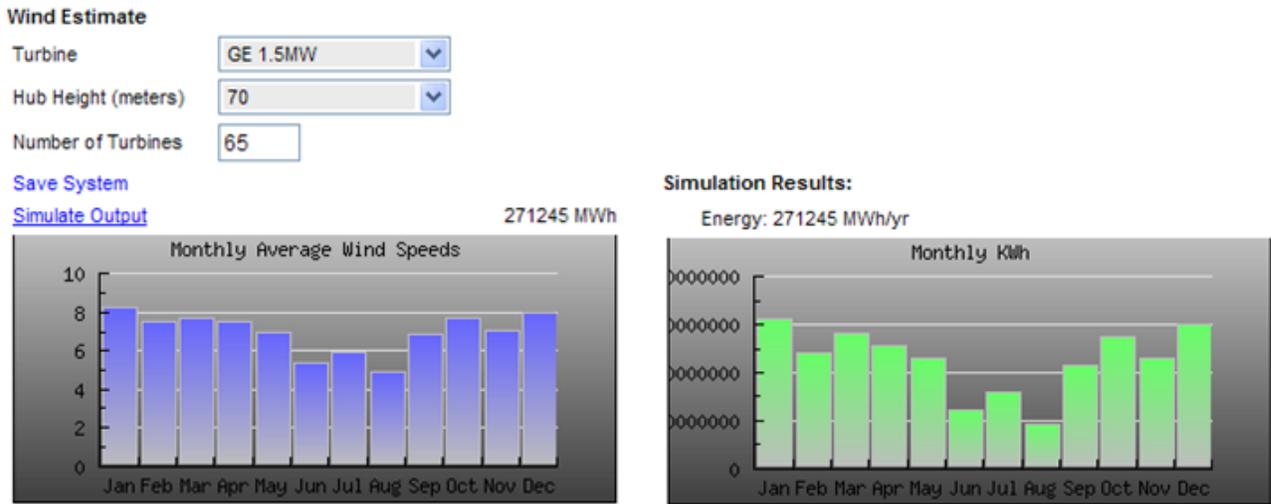
Figure 3.2.2.a.

For comparative purposes, Figure 3.2.2.b illustrates the simulation of the Vestas 27 wind turbine, using a 70 m hub height, and 65 towers for a total load of 1755 kW.

Wind Power Class 3 Simulation Results

Wind Estimate

Turbine	Vestas 27
Hub Height (meters)	70
Number of Turbines	65

Save System

Simulate Output   39325 MWh

Simulation Results:

Energy: 39325 MWh/yr
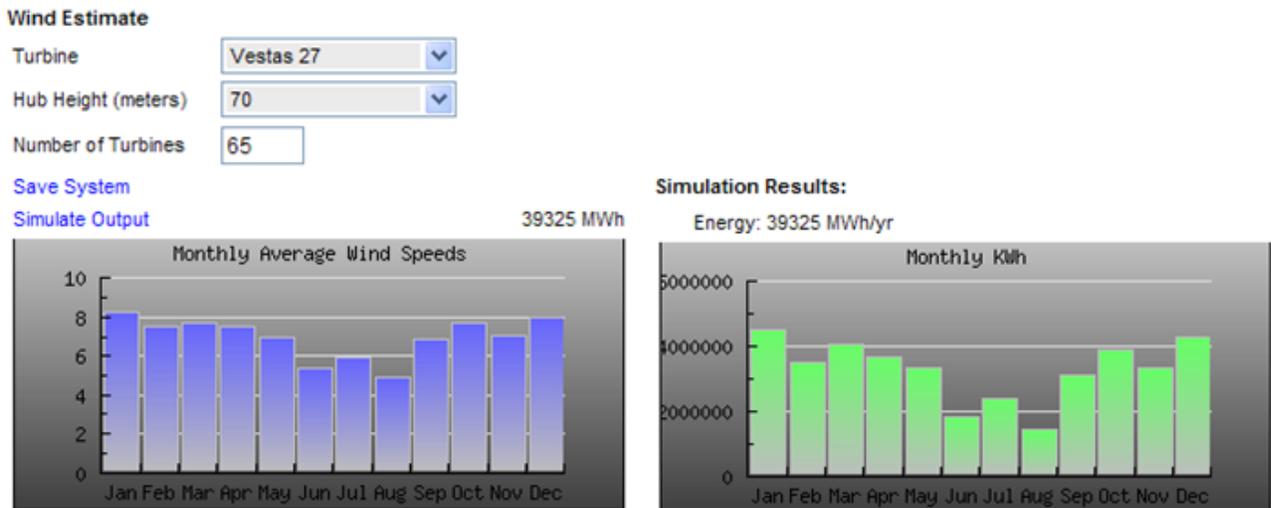
Figure 3.2.2.b.

3.2.3 Results

Area 2 has approximately 16 mi.² of available land suitable for wind farm development. Furthermore, approximately 200 MW of wind generated power could be developed in this area -- again, this is based on the overall available square miles within Area 2, rated at 5 MW per square kilometer (41 km² available in Area 2).

As illustrated in Section 3.2.2 and Appendix 2, the monthly average wind speeds are identical for any wind turbine chosen to be simulated. The monthly kilowatt hour/megawatt hour graphs are identical to the other graphs in shape; the only difference being the total energy output that was simulated by each turbine type.

Area 2 represents multiple challenges for NIPSCO and perhaps the local communities within this area. Smaller farm parcels means more negotiations, potentially more opposition, less towers per square acre (or per square mile) equates to lower total generation throughput to the grid. Rights-of-way and easements could be more costly. On the positive side, Area 2 has good accessibility to both 69 KV and 138 KV overhead transmission lines.

3.3 Area 3

3.3.1 Location

Area 3 is by far the largest contiguous Wind Power Class 3 area (over 350 mi^2) within the NIPSCO service territory. Unlike Area 2, this area incorporates multiple rural towns – including the towns of Wolcott, Remington, Goodland, Kentland, Earl Park, and Fowler – and includes vast large and open farming and/or ranch parcels.

As stated in Section 1.1.1, the town of Goodland, GEC's Site 9003 (Figure 1.1.1.a), had a 92 meter tall tower erected in northwest Indiana, in Newton County, near the town of Goodland, at an elevation of approximately 675 feet above sea level. GEC reported that this "site is flat and clear with no obstructions... The primary land use is farming."
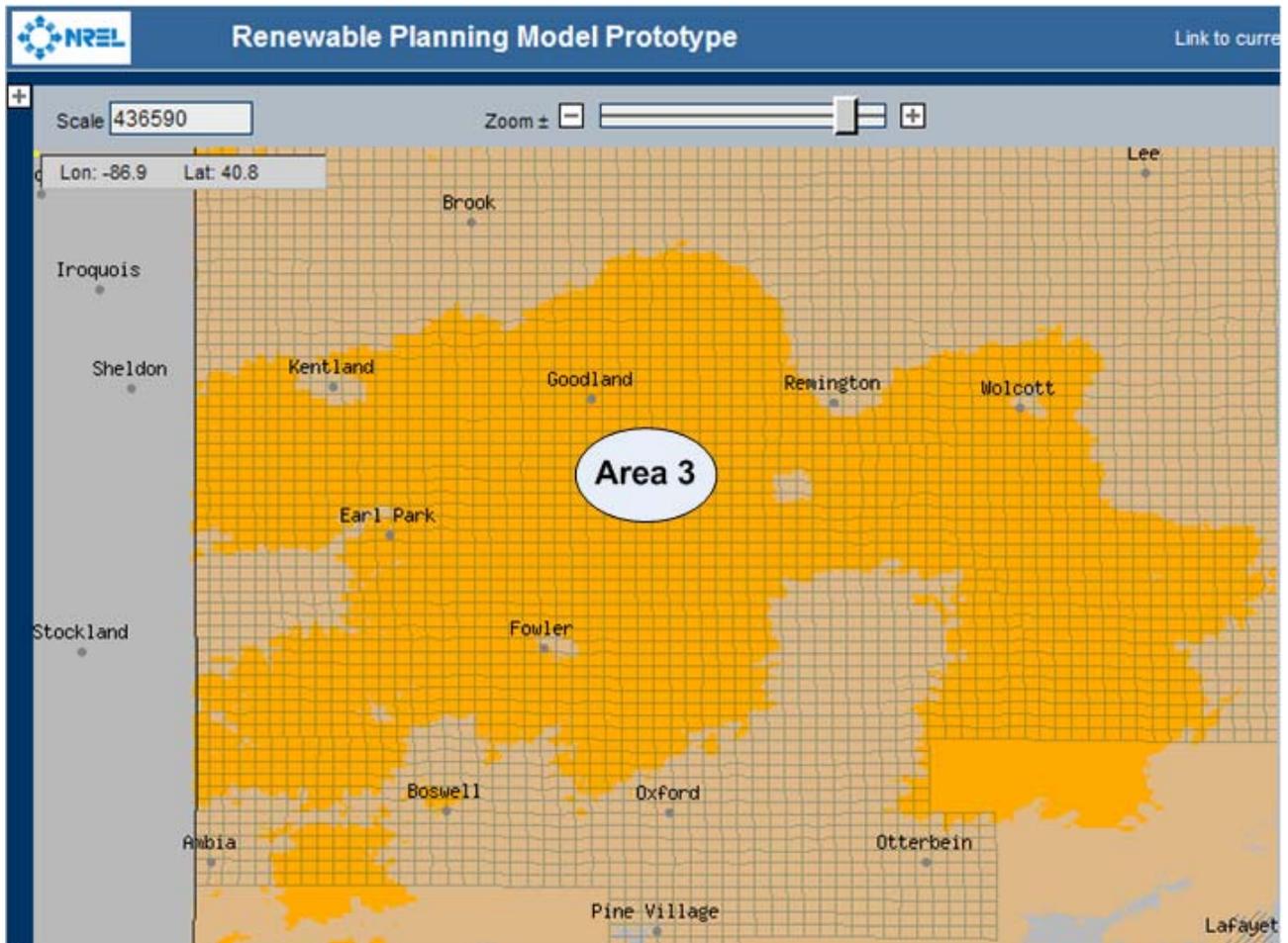
Figure 3.3.1. Area 3 Map

3.3.2 Various different wind turbines and the hub height

As stated earlier in Section 3.2.2, Area 2 and Area 3 have nearly the same identical Wind Power Class 3 profiles and wind generator simulations analyzed using NREL's RPM application for all of NIPSCO's minor map grid locations identified in both areas. All of the numerous simulations/graphs produced in the RPM application are illustrated in Appendix 2 to conserve document space.

For illustrative purposes only, Figure 3.3.2, is a simulation of the GE 1.5 MW turbine, using a 70 m hub height, and 65 towers for a total load of 100 MW.

Wind Power Class 3 Simulation Results
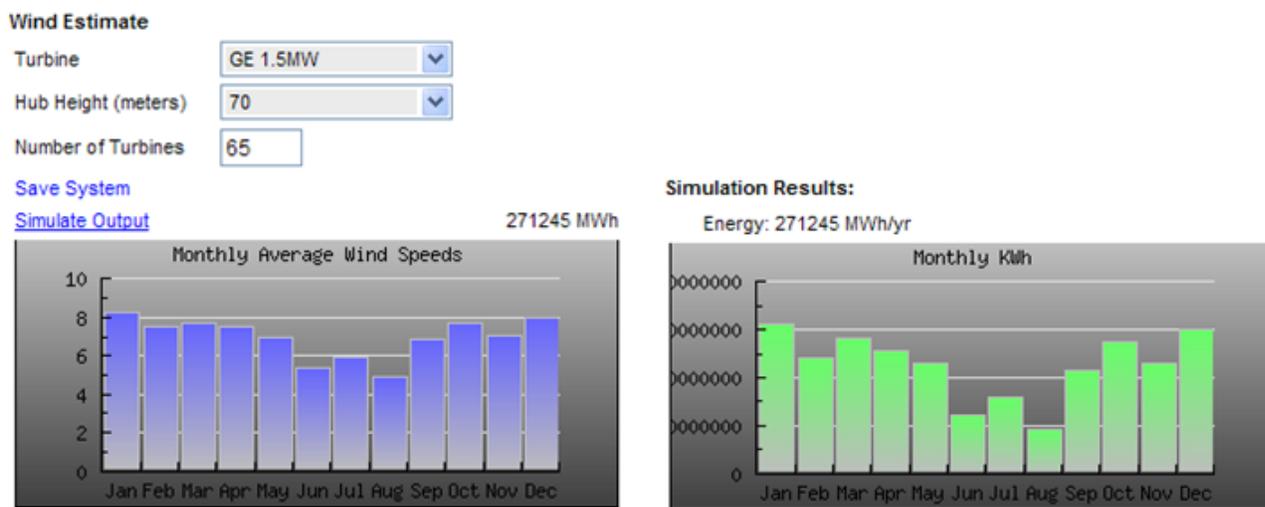
Figure 3.3.2. Wind estimate

3.3.3 Results

Area 3 is the largest contiguous Wind Power Class 3 land mass within the NIPSCO service territory (over 350 mi.²). The winds in this area contain enough energy to produce over 4500 MW of electric power annually. For the purposes of this study, we have again used 100 MW of annual wind generation as our baseline for wind simulation.

Based on the simulation graphs, a fully developed a 100 MW wind farm located in Area 3 could potentially yield 271,245 MWh/yr of electric energy using wind power.

Of particular interest to NIPSCO should be the Benton County Wind Farm that is currently being developed in Benton County, Indiana. BP Alternative Energy/Orion Energy LLC is developing this wind farm to take advantage of Benton County's topography and climate at Fowler Ridge located near Goodland. This project will be completed in 2007/2008 and is expected to generate enough power to supply the annual electrical needs of 150,000 homes.

Wind farm development in Area 3 should be considered the best location choice for NIPSCO based on all variables. This study recommends Area 3 for its consistent winds ridge, access to existing electrical transmission lines, and compatibility with existing agricultural uses of the land.

A distinct advantage for Area 3 is that there is access to existing 69 KV and 138 KV overhead transmission lines. The 138 KV circuit traverses through the communities of Remington, Goodland, and Kentland, then continues on to the Indiana/Illinois state line. Additionally, there are 69 KV circuits that traverse through the communities of Remington, Goodland, and Kentland, but also circles through farm parcels near the rural Earl Park and Fowler communities.

Rural communities in Area 3 are great locations to develop wind energy projects. Wind farms and farming/ranching have a well-established and harmonious relationship throughout United States and Europe. Farmers and ranchers in North America are also realizing that they can use their land not only to grow crops or raise cattle, but also to allow utilities like NIPSCO to develop and harvest electricity from the wind.

Wind energy is a special kind of commodity because it can deliver stable financial rewards with little or no effort on the part of the landowner. Since land owners would typically lease their land to NIPSCO, who build and operate the wind farm, they can earn money without having to expend a significant amount of time, energy, or capital themselves. Royalties generally pay in the thousands of dollars annually for each turbine, providing a great source of supplemental income for the landowners.

Land owners can not only lease their land to take advantage of Federal and local State incentives, but there is also an opportunity for them to become a wind energy producer themselves (small or large scale).

4. Wind Generation Background Information

4.1 Wind Condition Factors

There are two different types of wind that affect the earth's atmosphere. Together they determine the direction of the wind in a given locale. The first form is known as global wind or geostrophic wind. Geostrophic, or global wind, is not shaped by the surface of the earth because the average altitude is 1000 meters (3300 ft.) above ground level. These winds are driven by temperature and pressure gradients on a global basis and dictate the prevailing movement of weather systems. The direction of these winds is a function of the specific latitude of the locale in question. For NIPSCO, whose service territory is situated at approximately the latitude of ± 41ºN, a southwest prevailing wind direction exists.

The second form is known as surface wind. Ground surface roughness and obstacles are the main factors that affect this type of wind. Their effects can be measured at altitudes below 100 meters. Surface winds are also very heavily influenced by local thermal factors, the earth's surface roughness, terrain, lake, and land breezes, as well as hill and valley winds.

Lake and land breezes are a result of differences in neighboring water and shore temperatures. During the day, when the sun is shining, the land absorbs heat more quickly than the water. As the air heats, it rises and flows over the cooling water, creating a low-pressure area at ground level. This pressure differential attracts cool air from the lake and causes a wind to flow in a direction from the water to the land. Since the land breeze circulation is weaker than that of the lake breeze, the land breeze will likely possess less intense gradients of temperature, moisture and wind.[14]

Mountain (or large hills) and valley winds occur when a similar effect takes place on the south slope of a mountain, where the sun strikes in the northern hemisphere (this phenomenon is reversed in the southern hemisphere). As the sun heats the air, it rises slowly up the mountainside, and is then cooled, resulting in a wind current traveling back down the slope. The geography of the land and environmental factors greatly influence the wind speed and conditions.

Surface winds can be affected by different factors including the natural characteristics of the land. For this study, lake surfaces are considered the smoothest surface for measurement; landscapes with many trees and buildings are considered rougher.

Other factors affecting surface winds include obstacles such as buildings, trees, or rock formations that decrease the wind speed downstream from the obstacle. The degree to which obstacles affect wind speed depends on the object's porosity. The porosity value is found by dividing the open area of the object by the total area of the object facing the wind. For example, the porosity of a building would be equal to zero. The height and length of the obstacle also influence the slowdown effect on the wind.

Wind speeds are also influenced by terrain contours. A tunnel effect occurs when adjacent buildings or large hills are present. As the air approaches the structure, it becomes compressed causing the wind to speed up between obstacles. Another influence on wind speeds is known as the hill effect. This occurs when air approaching the face of a hill is exposed to the prevailing wind direction. The

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[14] Reference: A Lake and Land Breeze Primer, by Dr. David Sills, D.M.L., 1998, York University

air accelerates on the uphill slope, causing compression, then rapid expansion once it reaches the crest.

When siting a wind turbine, it is important to determine the effects of the outlined factors on wind conditions. Most importantly, one must look for an open view in the prevailing wind direction.

4.1.1 Wind Resources

Before turbines are installed, studies to determine wind speeds and prevailing wind directions must be completed. Wind conditions depend on different environmental factors, some of which have already been discussed. One major factor is the density of the ambient air, which is a function of both pressure and temperature. As the air becomes warmer, the air expands and the density of the air decreases, changing the amount of kinetic energy possessed by the wind. The energy content of the wind is proportional to the cube of the average wind speed. For example, if the wind speed is doubled, eight times as much energy will be converted from mechanical to electrical energy.

The speed of the wind is measured with anemometers. The most common anemometer is the cup anemometer. Constructed with a vertical axis and three cups, the anemometer serves to capture the wind and register the number of revolutions of the unit electronically. When measuring wind speeds for the evaluation of turbine sites, the anemometer should be mounted on top of a mast that is the same height as the prospective turbine's hub. It is strongly suggested that a reliable and properly calibrated anemometer be used when collecting data to determine if a wind energy project is feasible.

Once wind turbines are installed, anemometers are commonly located on the turbine nacelle to determine the current local wind conditions. This information can be fed to the on board control computers. This allows the turbine to operate most efficiently by maximizing the amount of time spent facing into the wind. The integration of this piece of equipment to the structure helps determine whether it would be beneficial to yaw the turbine against the wind to start the rotation of the blades. Wind conditions are measured and recorded on a data logger in order that the data can later be analyzed.

Prevailing wind direction is important when determining the positioning of a wind turbine. Wind roses, a type of radial plot that illustrates wind frequency, speed and energy compared to compass direction, are used to show the distribution of wind speeds and the frequency of varying wind directions. It should be recognized that in order to determine the actual wind conditions, measurements from the same anemometer should be taken over several years. Wind conditions can change as much at 10% per year, and it is important that this is taken into consideration when planning a project.

4.1.2 Wind Turbine Spacing

The purpose of wind turbines is to convert wind energy to electricity through a series of conversions from wind to mechanical energy, through the blades then mechanical to electrical energy with the generator. By taking energy from the wind, the speed and therefore kinetic energy behind the turbine is lower. This effect is known as the wake effect and the slowing of the wind downstream of the first turbine is known as wind shade. The wind exiting the blades is turbulent and in order to avoid wake effects and wind shade, towers are spaced at least 3 – 5 rotor diameters apart when the turbines are side by side. When one turbine is in front of another, at least 5 – 9 rotor diameters

should separate them. Although the distance between the turbines should be maximized to eliminate as much wind shade as possible, the cost effectiveness of having the units spaced closely together could pose problems due to excessive load on NIPSCO's electric grid.

4.1.3   Site Logistics

Wind conditions and factors that may influence their speed and direction are dependent on the location of the potential site. Once turbines are installed on an adequately windy site, the turbines will produce electricity. An energy delivery system must then be employed; large wind turbines produce a great amount of energy, which must be fed to the electrical grid.

4.1.4   Power Grid

The energy generated by wind turbines will be distributed through NIPSCO's electric grid. For the benefit of NIPSCO, peak winds occur during the daytime, when energy usage is at its highest. Winds are also higher in the winter months, when there is a greater demand for electricity.

This coincidence is valuable to NIPSCO since they purchase power at a higher price during peak load hours of the day. A good example of this phenomenon is lake or "offshore" breezes. It has been determined that offshore breezes, which occur during the day, are stronger than land breezes, which occur during the night.

At times when there is a calm, it is possible for the grid to actually feed energy to the generator, causing it to effectively work as a motor. For this reason, all electronic wind turbine controllers are programmed to allow the turbine to idle at times when it is not producing energy. The connection is reestablished once sufficient wind speeds allow the turbine to generate energy to distribute to the electric grid.

4.2   Types of Wind Turbines

Wind turbines can be generally separated into two types based on the axis about which the turbine rotates. Turbines that rotate around a horizontal axis are far more common today. Vertical-axis turbines are less frequently used, but have their advantages.

Wind turbines can also be classified by the location in which they are to be used. Onshore and offshore wind turbines have unique design characteristics, which are explained in more detail in the next sections.

4.2.1   Vertical Axis Wind Turbines

As stated above, vertical-axis wind turbines (or VAWTs), or commonly known as "eggbeater" turbines, are less frequently used. VAWTs employ a main rotor shaft running vertically, which can also be very large. The advantages of this arrangement are that the generator and/or gearbox can be placed at the bottom, near the ground, so the tower doesn't need to support it, and that the turbine doesn't need to be pointed into the wind thereby not requiring a yaw mechanism. Drawbacks are usually the pulsating torque that can be produced during each revolution and the drag created when the blade rotates into the wind. It is also difficult to mount vertical-axis turbines on towers, meaning they must operate in the often slower, more turbulent air flow near the ground, with resulting lower energy extraction efficiency.

Other factors such as a rotor design, that requires all blades to be removed in order to replace any one of them, and the fact that the turbine requires motor assistance to start, all make this type of turbine somewhat more complicated to maintain than horizontal axis models.

4.2.2   Horizontal Axis Wind Turbines

Horizontal-axis wind turbines (HAWT) have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. HAWT's can be further classified as either "downstream horizontal" or "upstream horizontal".

4.2.2.1   Downstream Horizontal Turbines

A downstream horizontal turbine is simply a system that has a horizontal axis of rotation, much like an airplane propeller, usually mounted on a pipe or lattice tower. The term 'downstream' refers to the orientation of the rotor in respect to the nacelle. In a downstream model, the nacelle points into the wind, with the rotor at the back of the unit, so wind must first flow around the nacelle, then to the rotor. The tower and nacelle are located in front of the rotor which blocks prevailing winds to some degree, leading to a lower efficiency than upstream models. The main advantage of downstream turbines is that the rotor acts as a rudder, eliminating the need for a yawing mechanism. The blades are somewhat more flexible than in an upstream model, which reduces stresses on the tower. In general, downstream models are more aptly suited to smaller turbine installations.

4.2.2.2   Upstream Horizontal Turbines

Upstream horizontal turbines are the most popular choice for commercial installations, and will be concentrated on in this study. The fact that the rotor faces into the wind avoids making the tower and nacelle obstacles. This reduces wind shade from the nacelle and tower to a minimum, comprised of only a small pressure gradient that has a marginal effect on turbine operation. The increased efficiency for this reason has made this design very popular, with the vast majority of manufacturers adopting it. To avoid the blades from bending under the pressure of the wind and colliding with the tower, they are constructed from a more rigid material than in a downstream operation. The nacelle also protrudes from the tower to allow adequate spacing between the blades and tower to reduce wind shade.

4.2.3   Generation Devices

4.2.3.1   Blades

The blades of a wind turbine function on very much the same principles as wings on an airplane. They are designed as airfoils, which provide lift by forcing air passing over the top of the blade to move more quickly than on the bottom, drawing the entire blade upward. Designs incorporating airfoils with asymmetrical cross sections and slightly twisted blades have helped to improve the efficiency of the rotor. The net effect of this on a turbine will cause the rotor to spin in a plane normal to the prevailing wind direction. The specific design of a given blade, including length, and cross-sectional shape will determine the aerodynamic characteristics of the blade, including optimal rotational speed and stall characteristics.

The blades themselves are usually made of glass fiber reinforced polyester or epoxy, which are less expensive than Kevlar reinforced models, and less susceptible to metal fatigue, a problem in

aluminum bladed props. The average rotational speed for a turbine is approximately 20-25 RPM, with some models operating as high as 30 RPM or as low as 15 RPM.

4.2.3.2   Rotor Size

The size of the turbine blades is related to the amount of power that a particular turbine can produce, the larger the blades, the more wind that can be harvested. A doubling of rotor diameter will increase power output by the power of 2 (i.e. a squared relationship). Since wind turbines, especially those on the commercial scale are so expensive; most manufacturers custom build blades specific to the intended site to provide maximum power output. Larger machines, such as the Vestas 1.8 MW turbine with a 66m-rotor diameter, are generally able to produce energy at a lower cost than smaller turbines, and the cost of building the base does not increase substantially with a larger rotor, boosting the economic return on a large-bladed machine. Larger turbines also have a much slower rotational rate than smaller models, which is considered by many to be an aesthetic advantage.

On the other hand, if the electrical grid does not have the capacity to accommodate a large generator, smaller blades, and therefore smaller production, are preferred. There is also increased reliability with a field of smaller turbines over one large turbine, as randomly occurring wind fluctuations usually cancel each other out, and will not affect all of the turbines in a group at the same time.

4.2.3.3   Number of Blades

It is generally accepted that even numbers of blades should be avoided on turbines for stability reasons. If an even number of blades is used, one blade will be at the top of the arc while one is at the bottom, in front of the tower. Because of wind shade caused by a pressure differential in the air stream in front of the tower, there will be less force applied to the bottom blade than on the top. The rotor will be bent upwards, due to this imbalance of force applied to the top blade by non-shaded wind, causing a rocking-horse effect. The most popular configuration to avoid this problem is the Danish three-blade concept, which keeps weight to a minimum, while optimizing balance and productivity. Two and one-bladed models are also available, but are much less popular.

4.2.3.4   Pitching System

Today's modern wind turbines have a hydraulic pitching system that allows fine regulation of the power output of the generator. It is pivotal in the optimization of power output and in more advanced systems can be used to slow the turbine in dangerously high winds. Pitching is the act of rotating the individual blades in tandem along their lengths with respect to the wind, which has great effects on the productivity of a turbine generator. The electronic controller constantly checks the power output at intervals of several times per second. If the blades are spinning too quickly, the mechanism will pitch the blades out of the wind, which will slow the turbine to a normal operating speed. Conversely, if there is very little wind, the blades can be turned into the wind, boosting output. In normal operation, pitch adjustments are constantly being carried out, although they are very minute, usually only a fraction of a degree at a time.

4.2.3.5   Drive Train

To make the production of electricity possible, a gearing system must be placed between the rotor and the generator, since a normal rotational speed for the rotor, depending on the size of the blades can be 30 RPM, while larger turbines can have rotor speeds as low as 15 RPM. There are a few commercial turbines that shift gears, but the vast majority relies on one fixed gearing ratio, which for larger turbines, is usually above 1 to 50. The low-speed shaft transfers the wind energy to the gearbox, and the high-speed shaft transfers the energy to the generator for conversion to electrical power.

4.2.3.6   Generator

Perhaps the most prominent factor that separates wind turbine generators from other types is the complications that accompany the start up of the hardware. Most turbines idle at low wind speeds because if they are connected to the grid without any wind driving the rotor, the direction of current will reverse, causing the generator to act as an electric motor. Additionally, if the generator is not turned on when wind picks up, there is no magnetic resistance to stop it from over speeding and damaging the hardware. If there is a 'hard' switch on the grid connection, the gearbox will be strained by a sudden flux in resistance, similar to a brake being suddenly applied to the quickly rotating gearing system. It is for these reasons that the 'soft start' method of switching on turbines was incorporated. Thyristors, a type of semiconductor used in light dimmers, are used to connect and disconnect the generator very gradually, phasing the current into the magnets, avoiding the mechanical and electrical shock of a 'hard start'. Since thyristors waste a small fraction of the energy fed through them, once the generator is operational, the thyristor is bypassed, minimizing losses of electricity.

Generators must also be equipped with a cooling system to maintain an acceptable operational temperature and to prevent overheating in the device. This is accomplished through the use of ventilation fans, and in some cases cooling fluid to remove hot air.

4.2.4 Orientation and Monitoring Systems

4.2.4.1   Anemometer and Wind Vane

The anemometer/wind vane apparatus acts as the eyes of the turbine. It measures both the direction and magnitude of incoming wind local to the turbine, which is vital information to the orientation of the blades. For maximum efficiency, the turbine must be facing directly into the wind. If the computer monitoring the wind vane detects a change in the wind direction, the turbine's direction can be adjusted to the correct bearing to optimize electricity output. It can also differentiate between gusts and consistent wind, so that the turbine direction is not adjusted unnecessarily. Such errors could decrease output by inappropriately adjusting direction.

4.2.4.2   Yaw System

Yawing is the act of adjusting the compass direction of the rotor and nacelle parallel to the ground (for example: north, south, east, and west.) The most common mechanism found in turbines is a system called forced yawing, which is a mechanical system that relies on an electric motor and a gearing system that rotates the nacelle to keep the turbine facing the wind.

The yawing mechanism is also equipped with brakes, which are kept locked when the system is not in use. This practice ensures that the nacelle does not rotate unless the yawing mechanism is being used, which is especially important in upwind turbines.

The yawing system is linked to the electronic controller, which receives updates from the anemometer several times a second so that adjustments to rotor direction can be made frequently. Another feature in modern turbines is a routine built into the controller, which counts the number of revolutions and direction the yawing mechanism has made. When the cables connecting the nacelle to the tower have made too many revolutions, the controller will automatically untwist these cables, preventing unnecessary wear.

4.2.4.3   Controller

The controller is a computer, mounted inside the nacelle that is constantly collecting performance data from the turbine. It uses this information to control the pitch and yaw of the turbine in order to attain optimum generation given the weather conditions. In addition to handling internal adjustments, the controller sends the information it collects, as well as service requests and alarms to the operator via electronic communications link, usually based on telephone lines, or network cable. Newer turbines are generally equipped with more than one controller. The internal sensors and switches are designed with redundancy to ensure availability, as well as a means to double check the accuracy of incoming information.

A modern wind turbine will allow 100 – 500 parameters to be monitored, including rotational speed of the rotor, generator, electrical output, internal and external temperatures, and even frequency and intensity of lightning strikes.

4.2.5 Structure

4.2.5.1   Nacelle

The nacelle is the housing of the turbine, usually constructed of steel for strength and durability. It protects all of the internal components from the elements, providing an insulated and weatherproof shelter for them. Nacelles can be as small as a few feet long in residential turbines, while commercial nacelles can be as large as a coach bus. The nacelle may be accessed by maintenance staff via the tower or from the roof of the nacelle.

4.2.5.2   Tower Types

Commercial wind turbines are generally constructed on conical steel or concrete towers. The rounded shape of the tower minimizes turbulence and wind shade, a problem faced commonly with lattice towers. It also is able to support much greater loads than a standard strut and guy wire design. Generally there are service ladders inside the tower structure, allowing operations personnel to access the nacelle from the ground. The actual height of a specific tower(s) must be determined through subsequent wind studies that will determine the optimal hub height, given local wind patterns.

4.3   Wildlife and Wind Energy

Wildlife studies have shown that wind farms with sensitive siting have no significant adverse effect on avian populations. The wind energy industry is investing in closely monitoring this important issue and continues to work vigilantly to avoid any significant impact.

The energy in the wind is free to be captured and can help offset the effects of climatic changes. Wind farms can also be developed with respect for habitats -- addressing to significant threats to birds and other forms of wildlife.

4.3.1 Avian's and wind turbines

There are a few ways that wind turbines might interfere with birds, one is the potential impact to their natural habitat, and another is through possible collisions with the turbines themselves. A well sited wind farm goes a long way towards minimizing the risk to birds and brings about a natural and healthy coexistence between wind energy and avian creatures of all types.

A steady reviewing the impact of wind farms on birds in the United States, found that generally, only two birds per turbine per year ever die in collisions with wind turbines.[15] Bear in mind that this is far less than the millions of deaths per year associated with birds crashing into buildings and windows[16], and many millions of deaths associated with birds colliding with vehicles.

According to research[17], it is estimated that nearly 500 million to possibly over one billion birds are killed annually in the United States due to anthropogenic sources including collisions with human made structures such as vehicles, buildings and windows, power lines, communication towers and wind turbines. Additional incidents include electrocutions; oil spills and other contaminants; pesticides; cat predation; and commercial fishing by-catch.

4.4   Visual and Sound Concerns

People typically have a number of questions about wind turbines regarding the visual and audio aspects. Are they really big? How much sound do they produce? What will it look like when the wind farm goes up in my community?

Being interested, NIPSCO will want answers to these questions and more because building wind farms that address the needs and wishes of the local communities is the way to build a renewable energy to benefit all energy users.

4.4.1 Visual

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[15] Avian Collisions with Wind Turbines: a Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States, August 2001 -- National Wind Coordinating Committee (NWCC) Resource Document; http://www.osti.gov/bridge/purl.cover.jsp?purl=/822418-vE68OX/native/

[16] Collisions Between Birds and Windows: Mortality and Prevention. 1990 Daniel Klem, Jr., Department of Biology, Muhlenburg College, Allentown, PA -- Journal of Field Ornithology, 1990, 61 (l): 120-128

[17] A Summary Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions, 2005, Wallace P. Erickson, Gregory D. Johnson, and David P. Young Jr.; USDA Forest Service Gen. Tech. Rep. PSW-GTR-191

Let's face it; there is no hiding a wind turbine. They can be 30 stories tall and tend to be set in clusters. Some people find beauty and elegance in the sleek and modern structures of today's wind turbines. Furthermore, many of the same people are residents who live closest to the wind farms.

Studies in European countries were wind farms are prevalent show that proximity to the nearest turbine seems to have a surprising effect on people's attitudes. Residents who live closer than 500 m to the nearest wind turbine tend to be even more positive about wind energy than people sited further away.[18]

Developers of today's wind farms recognized that visual impacts are a concern for the community. That's why so much effort goes into the planning stages of a wind energy project. Developers of wind farms are also looking for new and innovative ways to reduce impacts and gain consent of the community.

Computer aided modeling programs, which utilize Geographic Information System (GIS) technology, can be used to show residents exactly what the landscape will look like once the farm is installed. These programs provide the community with visual answers to their questions. Residents get to see the wind farms from different perspectives, including how it may look from the local community center, nearby school, or an individual home or business.

4.4.2 Sound

Modern wind turbines are not noisy. However, any mechanical device has the potential for mechanical noise, i.e. the sound emitted when two parts rub together. The good news is that this type of sound has virtually disappeared from today's well engineered, modern turbine.

In fact, turbines are so quiet that is possible to carry on a normal conversation at the base.[19] At 300 m from the base, the sound they make has been electronically measured and compared to a whispering voice.

Wind turbines operate under windy conditions, the harder the wind blows the faster the turbine spins. However, much of the sound from the blades is masked by the sound of the wind itself and of the accompanying sound of rustling of rustling leaves in nearby trees and shrubs.[20]

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[18] Anderson et. al. (1997)
[19] Facts About Wind Energy and Noise fact sheet – http://www.awea.org/pubs/factsheets/WE_Noise.PDF
[20] Reference: The British Wind Energy Association paper, BWEA_are wind turbines noisy.pdf, also available electronically at http://www.bwea.com/ref/noise.html

5.   Cost of Wind Energy

The cost of wind energy is determined by:
- the initial cost of the wind turbine installation
- the interest rate on the money invested
- the amount of energy produced

Any wind turbine that is installed in a very windy area generates less expensive electricity than the same unit installed in a less windy area. So it's important to assess the wind at the potential site.

Today's wind turbine generators cost between $1500 and $2000 per kilowatt for wind farms that use multiple-unit arrays of large machines. Smaller individual units cost up to $3000 per kilowatt. In good wind areas, the costs of generating electricity range between five and ten cents per kilowatt hour. That cost is somewhat higher than the costs associated with an electrical facility, but wind energy costs are decreasing every year, whereas most conventional generation costs continue to increase.

5.1 Sample Project Cost

Melancthon I Wind Project[21] developed by Canadian Hydro Developers Inc.; the project's construction commenced in the spring of 2005 and went online March 4, 2006.

- Capital costs of $126 million CAD or approximately $116 million USD
  - Approximately $12-14 million CAD for preconstruction activities including engineering, planning, security, fencing, and environmental screening; and
  - Approximately $112 million CAD for construction activities, including labor, equipment, and materials.
- 45 GE wind turbines, each rated at 1.5 MW
- Total capacity of 67.5 MW
- Number of area companies employed: > 25
- Value of area contracts: > $15 million CAD or approximately $13.8 million USD
- Construction man-years created: 77
- Full-time operating positions: 8
- Annual average power output: ±195 GWh
- Tower type: tube/80 m hub height
- 55 km of new power lines
- 1 electrical substation
- 1 operations and maintenance building
- 24 km of new roads, plus 2 km of upgraded road
- Projected operational life: 30 years

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[21] www.mgwindpower.info

5.2 Benefits

5.2.1 Environmental

While the wind turbines are producing electricity, the load on other generators is decreased. This will reduce the amount of greenhouse gas emitted by conventional power generators.

An advantage of using wind as a source of electric power generation is that it is completely renewable. That is, it will never run out as long as the sun exists to provide thermal currents.

In order to use fossil fuel for power generation, the fuel must be mined from underneath the earth's surface. This usually requires mining and drilling, which can involve deforestation and stripping. This process is not sustainable, as there is a limit to how much energy can be extracted from the source.

The estimated amount of fossil fuel available for future consumption is vague at best, with one source citing reserves of oil, natural gas, and coal to be 46, 63, and 230 years respectively. In a recent US government file however, it was stated, "new discoveries of natural gas in the United States have fallen for three straight years. This leads to inconclusive figures of exactly how much fossil fuel is actually available for consumption, making renewable resources an attractive option.

Another advantage of wind power over fossil-fuel sources is a reduction of greenhouse gas emissions. Based on the Wind Energy 2006 Pollution Offsets, the US Department of Energy reports that particulates that would have otherwise been released into the atmosphere from other sources of power generation include: nearly 6.4 million tons of carbon dioxide (CO_2), more than 14,000 tons of sulphur oxide (SO_x), and more than 9,000 tons nitrogen oxide (NO_x). By convention, CO_2 is reported in tons of carbon: 3.7 tons of CO_2 contains 1 ton of elemental carbon.

5.2.2 General

- Wind energy is an ideal renewable energy because:
    - it is a pollution-free, infinitely sustainable form of energy
    - it doesn't require fuel
    - it doesn't create greenhouse gasses
    - it doesn't produce toxic or radioactive waste.
- Wind energy is moderately quiet and does not present any significant hazard to birds or other wildlife.
- When large arrays of wind turbines are installed on farmland, only about 5% of the land area is required for the wind turbines. The rest is available for farming, livestock, and other uses.
- Landowners often receive payment for the use of their land, which enhances their income and increases the value of the land.
- Ownership of wind turbine generators by individuals and the community allows people to participate directly in the preservation of our environment.
- Each megawatt-hour of electricity that is generated by wind energy helps to reduce the 0.8 to 0.9 tons of greenhouse gas emissions that are produced by coal or diesel fuel generation each year.

Appendix 1 NREL Renewable Planning Model (RPM)

Renewable Planning Model (RPM)
Project Information

*Concept: **Interactive visualization and assessment tool to assist in locating potential sites, and understanding the impacts of renewable power systems at those sites.***

The Renewable Planning Model (RPM) prototype creates interactive composite map views to assess the feasibility of renewable energy production. The tool is a web-based application that is designed to be easy to modify, distribute and use.

RPM is a working prototype that can integrate basic resource availability (i.e. solar irradiation, wind resource, etc.) with infrastructure constraints (e.g., power distribution capacity, distance to roads, ground steepness, etc) into a single web-based geographic interface.

RPM also allows the user to analyze a specific potential site and conduct a virtual site visit. By using detailed terrain based imagery, the user can review the physical details of potential sites. This includes interactive site estimation tools that use NREL models to assess site and system specifics (i.e. correlation of feeder load to renewable power production, projected load risk with and without a proposed system, etc.)

Current Prototype Functions

Highlight potential renewable generation within a region

- Interactive, web-based tool
- Geographic Information System(GIS) filters for base resources (i.e. Solar, Wind)
- Show partial layers (thresholding) for resources and demand factors (i.e. population growth, solar intensity).
- Filters based on distance to infrastructure and terrain feasibility factors.
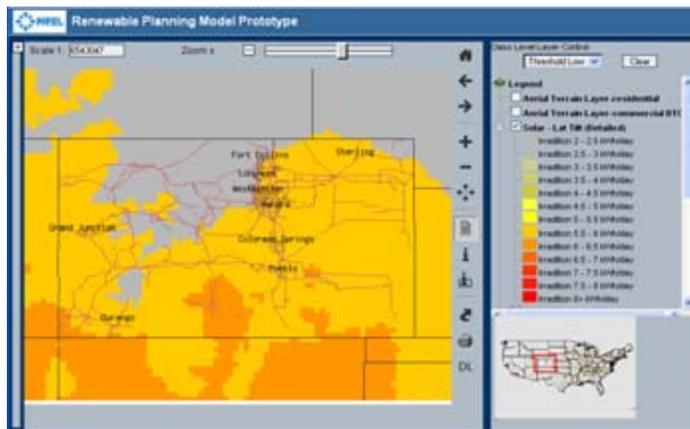
Virtual site tour and interactive system simulation

- Preview site using terrain imagery 'virtual visit'. Imagery resolutions down to 1 foot/pixel.
- Draw systems on top of imagery and assess site specifics
- Simulate hourly power output for user drawn systems
- Aggregate systems together for larger scale assessment of load vs. power
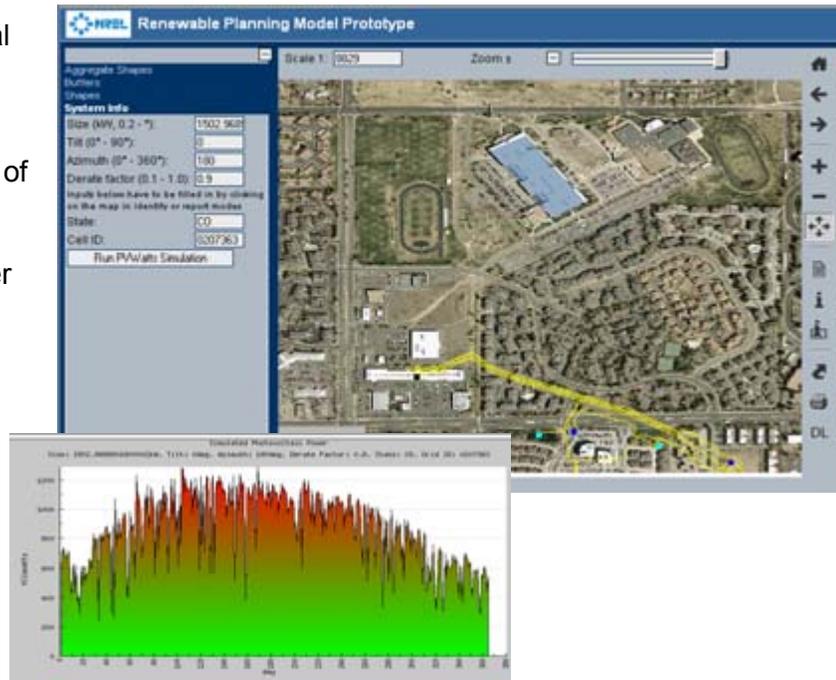
Future Phases

Expand System Analysis

- Generalize systems to include generators, turbines, and storage
- Show fluctuations from mean estimated power (95% probable power levels along side mean values)
- Introduce cost based system assessment
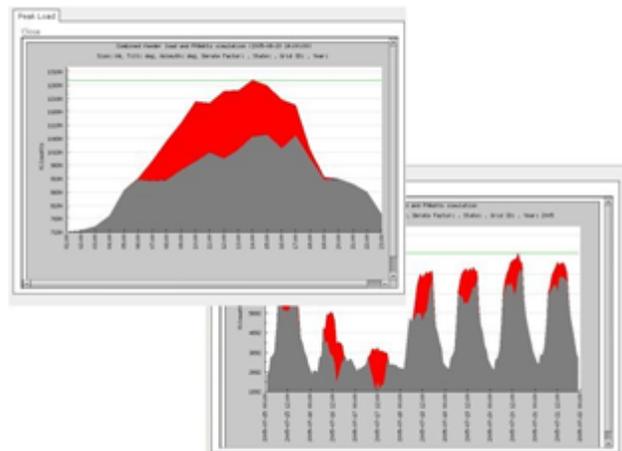
Assess electrical impacts

- Integrate external analysis tool into RPM workflow
- Evaluate power grid system impacts of proposed renewable systems

Appendix 2 Area 2 and Area 3 Wind Power Simulations

Wind Estimate

Turbine: GE 1.5MW

Hub Height (meters): 50

Number of Turbines: 65

Save System

Simulate Output   253110 MWh

Monthly Average Wind Speeds
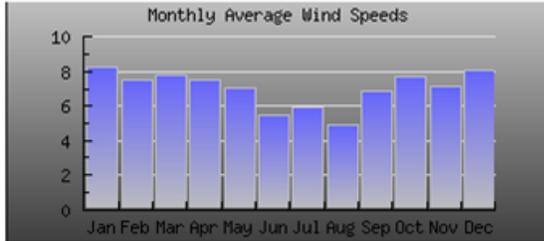
GE 1.5 MW Wind Turbine – 50 M

Simulation Results:

Energy: 253110 MWh/yr

Monthly KWh
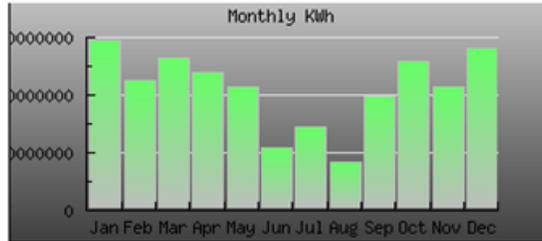
Wind Estimate

Turbine: GE 1.5MW

Hub Height (meters): 60

Number of Turbines: 65

Save System

Simulate Output   262015 MWh

Monthly Average Wind Speeds
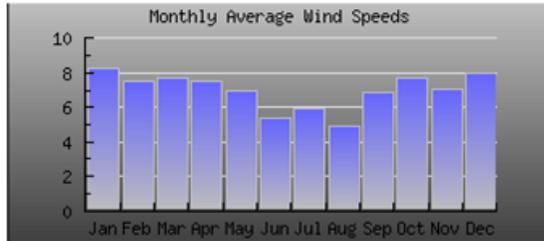
GE 1.5 MW Wind Turbine – 60 M

Simulation Results:

Energy: 262015 MWh/yr

Monthly KWh

Wind Estimate

Turbine: GE 1.5MW

Hub Height (meters): 70

Number of Turbines: 65

Save System

Simulate Output   271245 MWh

Monthly Average Wind Speeds

GE 1.5 MW Wind Turbine – 70 M

Simulation Results:

Energy: 271245 MWh/yr

Monthly KWh

Wind Estimate

Turbine	Vestas 47
Hub Height (meters)	50
Number of Turbines	65

Save System

Simulate Output   120380 MWh

Vestas 47
Wind Turbine – 50 M

Simulation Results:

Energy: 120380 MWh/yr

Wind Estimate

Turbine	Vestas 47
Hub Height (meters)	60
Number of Turbines	65

Save System

Simulate Output   125255 MWh

Vestas 47
Wind Turbine – 60 M

Simulation Results:

Energy: 125255 MWh/yr

Wind Estimate

Turbine	Vestas 47
Hub Height (meters)	70
Number of Turbines	65

Save System

Simulate Output   129285 MWh

Vestas 47
Wind Turbine – 70 M

Simulation Results:

Energy: 129285 MWh/yr

49

Wind Estimate

Turbine	Vestas 47
Hub Height (meters)	50
Number of Turbines	65

Save System

Simulate Output — 120380 MWh

Vestas 47
Wind Turbine – 50 M

Simulation Results:

Energy: 120380 MWh/yr

Wind Estimate
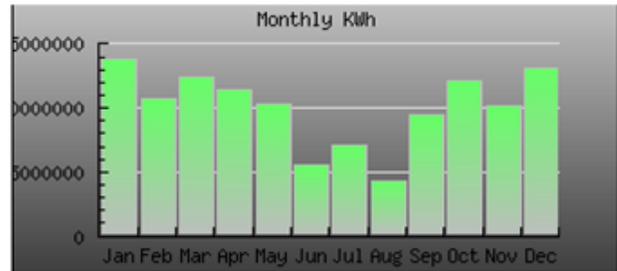
Turbine	Vestas 47
Hub Height (meters)	60
Number of Turbines	65

Save System

Simulate Output — 125255 MWh

Vestas 47
Wind Turbine – 60 M

Simulation Results:

Energy: 125255 MWh/yr

Wind Estimate

Turbine	Vestas 47
Hub Height (meters)	70
Number of Turbines	65

Save System

Simulate Output — 129285 MWh

Vestas 47
Wind Turbine – 70 M

Simulation Results:

Energy: 129285 MWh/yr

Wind Estimate
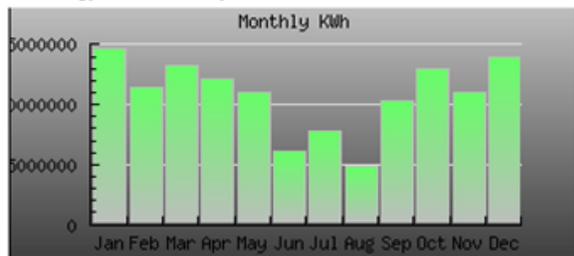
Turbine	Vestas 27
Hub Height (meters)	50
Number of Turbines	65

Save System
Simulate Output   36855 MWh
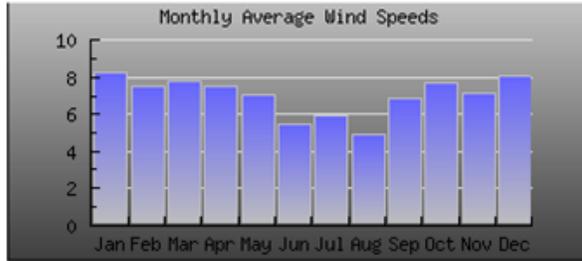
Vestas 27
Wind Turbine – 50 M

Simulation Results:
Energy: 36855 MWh/yr
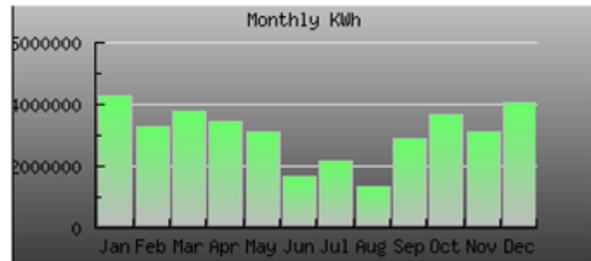
Wind Estimate

Turbine	Vestas 27
Hub Height (meters)	60
Number of Turbines	65

Save System
Simulate Output   38025 MWh
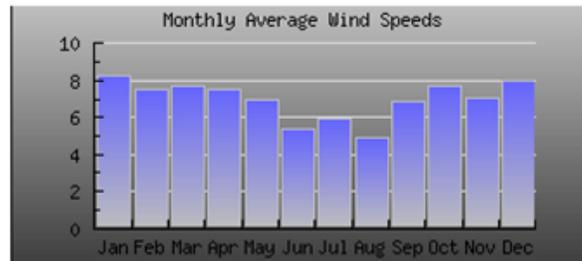
Vestas 27
Wind Turbine – 60 M

Simulation Results:
Energy: 38025 MWh/yr
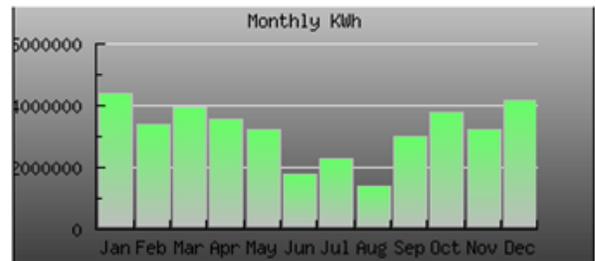
Wind Estimate

Turbine	Vestas 27
Hub Height (meters)	70
Number of Turbines	65

Save System
Simulate Output   39325 MWh
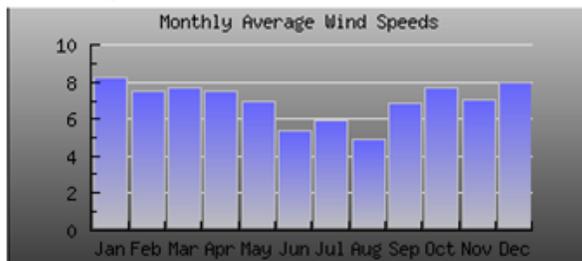
Vestas 27
Wind Turbine – 70 M
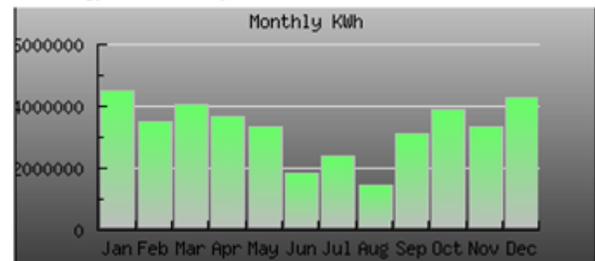
Simulation Results:
Energy: 39325 MWh/yr

51

Wind Estimate

Turbine	Generic 10KW
Hub Height (meters)	50
Number of Turbines	65

Save System

Simulate Output   1755 MWh
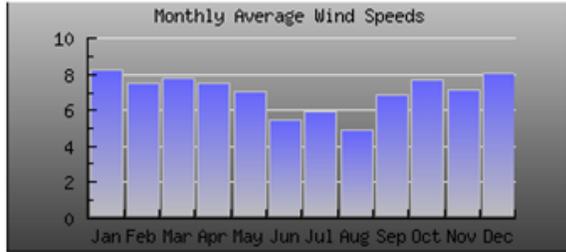
Generic 10 KW
Wind Turbine – 50 M

Simulation Results:

Energy: 1755 MWh/yr
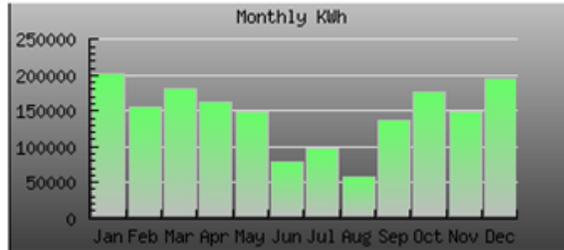
Wind Estimate

Turbine	Generic 10KW
Hub Height (meters)	60
Number of Turbines	65

Save System

Simulate Output   1820 MWh
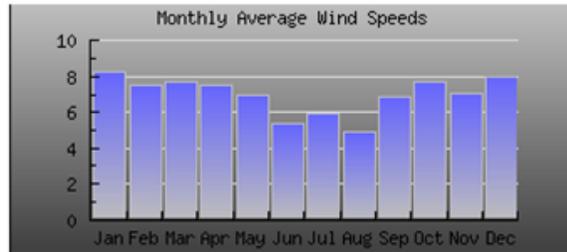
Generic 10 KW
Wind Turbine – 60 M

Simulation Results:

Energy: 1820 MWh/yr
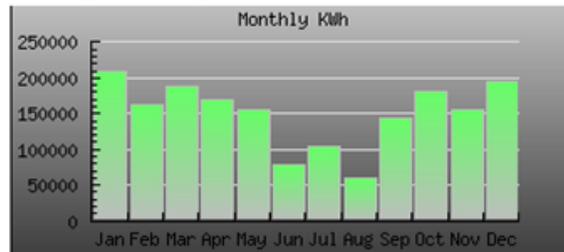
Wind Estimate

Turbine	Generic 10KW
Hub Height (meters)	70
Number of Turbines	65

Save System

Simulate Output   1885 MWh
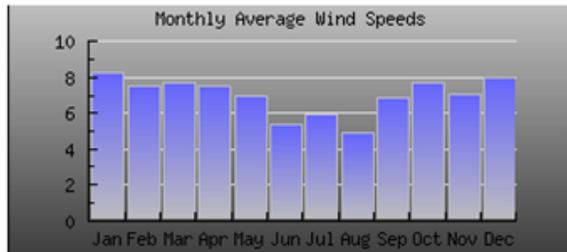
Generic 10 KW
Wind Turbine – 70 M

Simulation Results:

Energy: 1885 MWh/yr
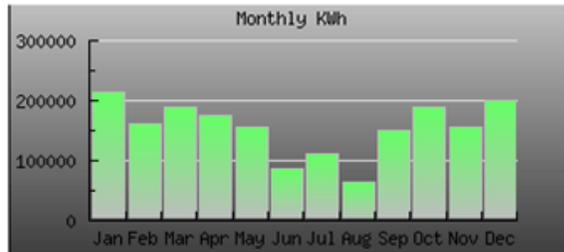
Wind Estimate

Turbine: Generic 3KW

Hub Height (meters): 50

Number of Turbines: 65

Save System

Simulate Output 520 MWh
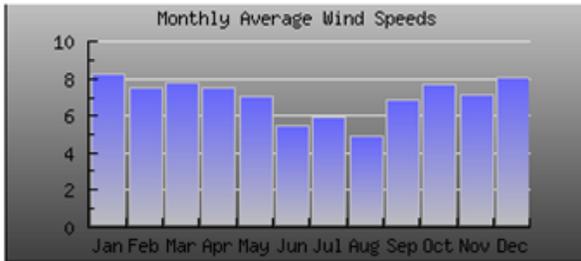
Generic 3 KW
Wind Turbine – 50 M
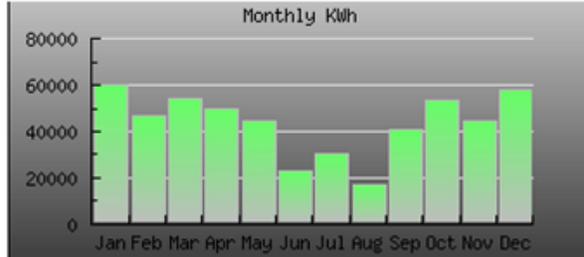
Simulation Results:

Energy: 520 MWh/yr

Wind Estimate

Turbine: Generic 3KW

Hub Height (meters): 60

Number of Turbines: 65

Save System

Simulate Output 520 MWh
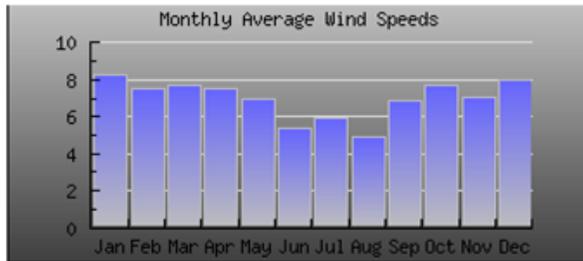
Generic 3 KW
Wind Turbine – 60 M
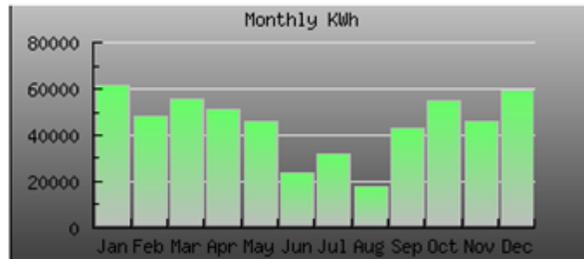
Simulation Results:

Energy: 520 MWh/yr

Wind Estimate

Turbine: Generic 3KW

Hub Height (meters): 70

Number of Turbines: 65

Save System

Simulate Output 585 MWh

Generic 3 KW
Wind Turbine – 70 M
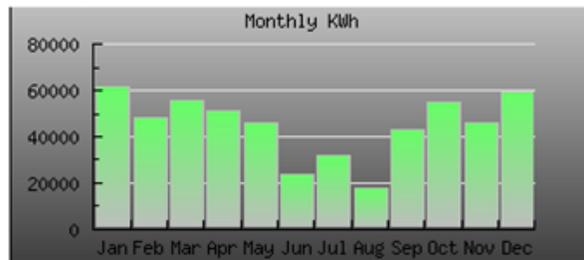
Simulation Results:

Energy: 520 MWh/yr

Wind Estimate

Turbine	Skystream 3.7
Hub Height (meters)	50
Number of Turbines	65

Save System

Simulate Output   520 MWh

Monthly Average Wind Speeds

Skystream 3.7 KW
Wind Turbine – 50 M

Simulation Results:

Energy: 520 MWh/yr

Monthly KWh

Wind Estimate

Turbine	Skystream 3.7
Hub Height (meters)	60
Number of Turbines	65

Save System

Simulate Output   520 MWh

Monthly Average Wind Speeds

monthly average wind

Skystream 3.7 KW
Wind Turbine – 60 M

Simulation Results:

Energy: 520 MWh/yr

Monthly KWh

Wind Estimate

Turbine	Skystream 3.7
Hub Height (meters)	70
Number of Turbines	65

Save System

Simulate Output   520 MWh

Monthly Average Wind Speeds
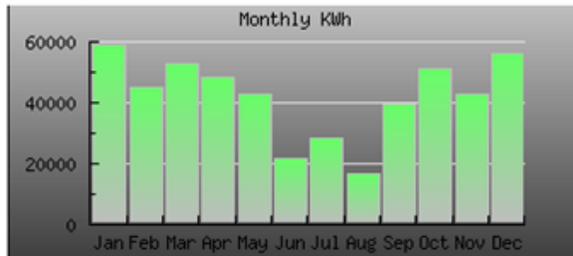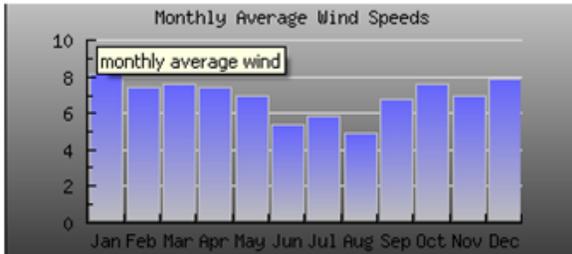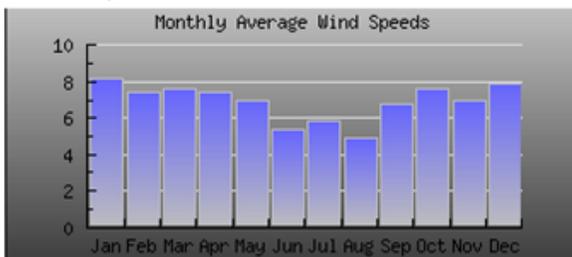
Skystream 3.7 KW
Wind Turbine – 70 M

Simulation Results:

Energy: 520 MWh/yr

Monthly KWh

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14. ABSTRACT *(Maximum 200 Words)*
This report describes Northern Indiana Public Service Co. project efforts to develop an automated energy distribution and reliability system. The purpose of this project was to implement a database-driven GIS solution that would manage all of the company's gas, electric, and landbase objects. This report is second in a series of reports detailing this effort.

15. SUBJECT TERMS
automated energy distribution and reliability system; AEDR; geographic information system; GIS; Northern Indiana Public Service Co.; NIPSCO; National Renewable Energy Laboratory; NREL

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