Hazard Management System Demonstration

NS3/Safety & Mission Assurance

JSC White Sands Test Facility

March 2005

The JSC/WSTF contingent heads over the rainbow with tales of a magical Hazard Management System.

Meanwhile, crafty contractors scheme to exploit the wonders of information technology for the sake of improved ground safety.

Outline

- The Team
- Background
  - Worksite Analysis & the Hazard Management Paradigm
- System Objective
- Proposed System Capabilities
- Applicable NASA Requirements
- System Demonstration
- Hazard Management Leading Metrics
- Products -- What we got & What we want

The Team

Angela Luna – WSTF S&MA, Project Manager

Don Hall – WSTF S&MA, Hazard Analysis and Safety Reqmts

Case Van Dyke – HTSI Safety, Project Leader

Denzil Burnam – HTSI Safety, User/Data Consultant

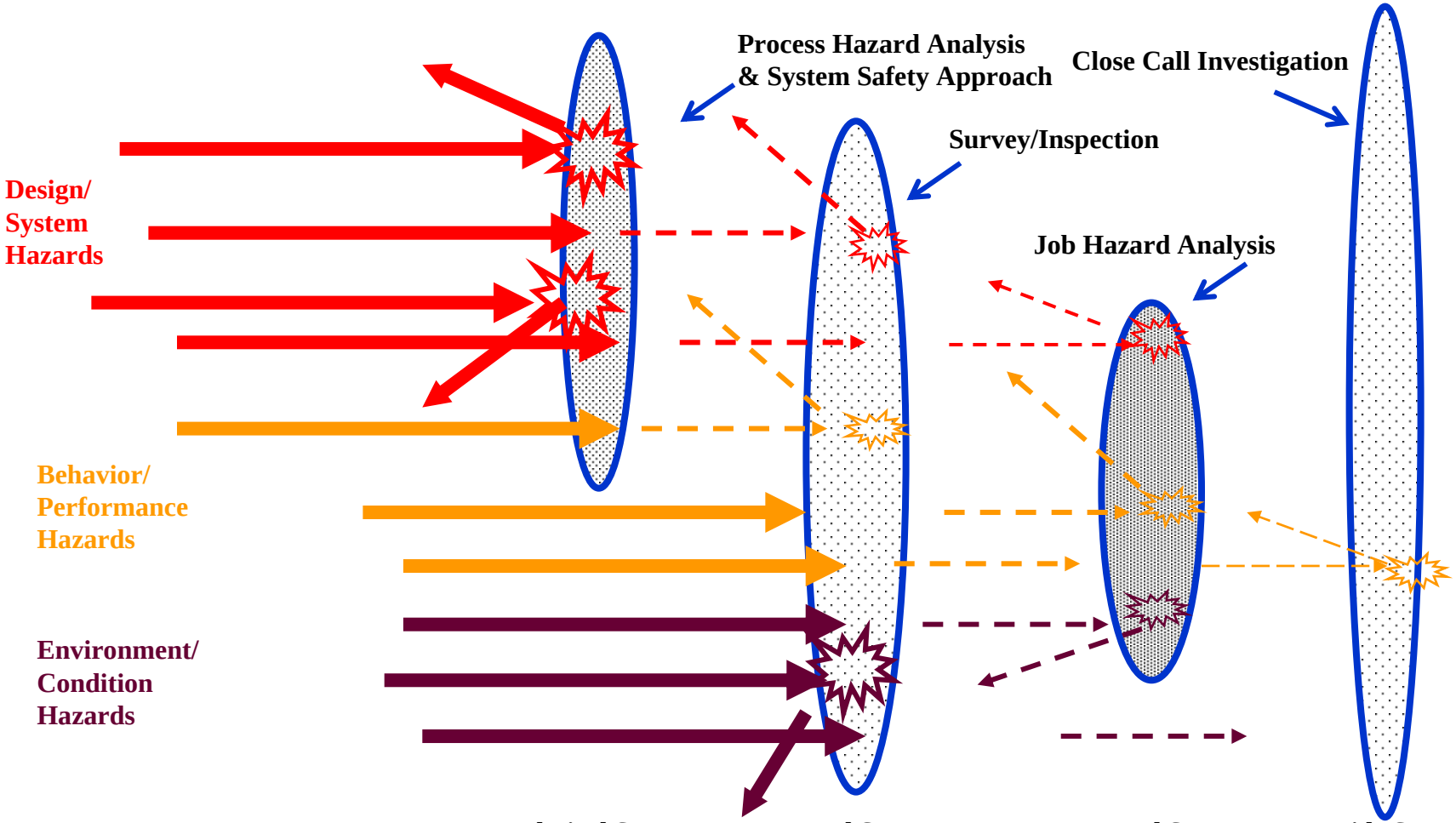
Ted Lillys -- HGL, Project Manager

Gerald Burnette -- HGL, The Man Behind the Curtain

Background

- **Pervasive and comprehensive requirements driving hazard management from multiple perspectives**
  - **Hazardous conditions noted in inspections**
  - **Job Hazard Analysis focus on individual behaviors**
  - **Process Hazard Analysis focus on systems**
  - **Worksite Analysis focus on environmental conditions and potential exposures**
- **Multiple requirements resulting in overlap in analysis techniques and results, driving inefficiencies and confusion**
- **Greater emphasis on employee involvement driving need for quick, concise access to, and communication of, relevant hazards and associated controls**
- **Hunger for real time hazard assessment**

Worksite Analysis -- Screening Out Hazards



The Hazard Management Paradigm

- Different tools
- Different products
- Different audiences
- Different uses
- One common element…

IDENTICAL HAZARD INFORMATION!!!!

System Objective

Need an information system that sorts individually identified hazards independent of the activity, technique, or tool used, and manages the hazard, it's analysis, control, and communication.

System Capabilities

- Internet accessible
- Security controls on access and modification
- Keyboard entry of “new” hazards
- View existing hazard documentation
- Indexing of hazards to identify:
  - Location
  - ❖ Categorization of hazard to identify exposure type, i.e. explosive, toxic, impact, etc.
  - ❖ Component
  - Affected Employee (Position)
  - ❖ Hazard Severity, Probability, and Risk Assessment Code
  - ❖ Control codes, direction, and references
  - Control owner (Name)
- Multiple standard sorts and reporting features
  - ❖ These are “what we want” items

System Capabilities

- Facilitate "build" of hazards analyses based on pick lists of standard hazard categories and allowing for tailored entries
  - Process Hazard Analysis
  - Job Hazard Analysis
  - FMEA
  - Inspection/Survey Report
  - System Safety Analysis
- Recommend controls citing hazard reduction precedence
- Assign actionees for control and schedule suspense targets
- Track hazard analysis control status based on application sort -- facility, system, component, location, affected employee, etc.
- E-mail notification features for control input, action response, and scheduled maintenance (PSM)
- Electronic approval authorities for reports
- Adaptable to any other NASA facility
  - These are "what we want" items

Hazard Management Metrics

Improvement Factor –

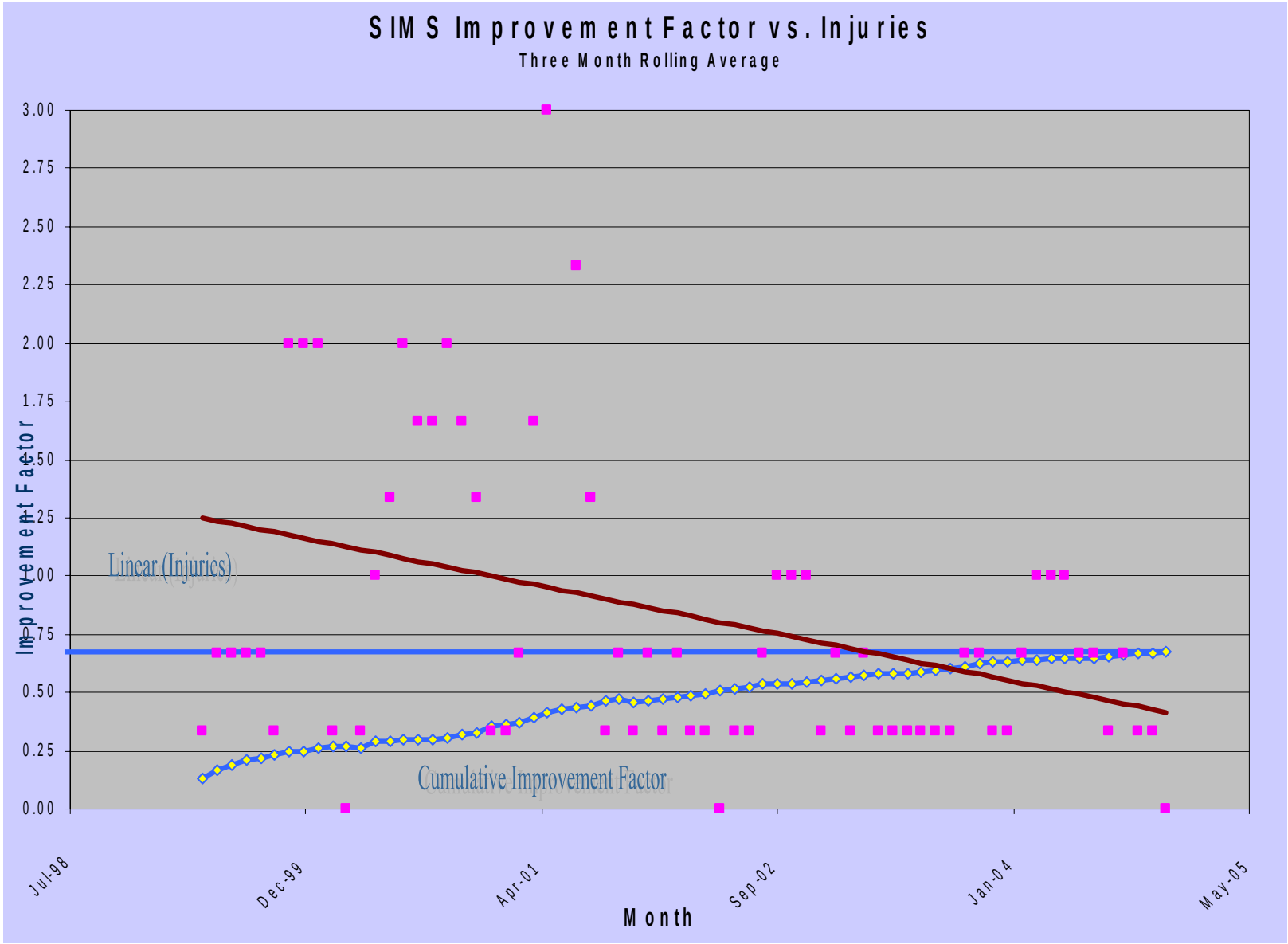
Prototyped at WSTF, this metric provides for running ratio of positive to negative findings. Provides "leading metric" for safety culture maturity based on inspection results.

Hazard Control Maturity Index –

Allows for aggregate measurement of task, system, area, or process hazard control effectiveness based on hazard reduction precedence level of applied controls. The metric control improvement, thereby bolstering mishap prevention efforts.

Graphic Information System Hazard Visualization

Allows for visual representation of overall hazards present in a given geographical area based on the number and RAC level of managed hazards in the associated area.


SIMS Improvement Factor vs. Injuries
Three Month Rolling Average
Improvement Factor
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Linear (Injuries)
Cumulative Improvement Factor
Jul-98
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Month

GIS Hazard Visualization

Hazard Analysis (HA)

WSI 04-SW-0002, Hazard Recognition & Control

Hazard Reduction Precedence Sequence

- **Design to Eliminate the Hazard**
  - **EXAMPLE -- Use Referee Fluid**
- **Provide Engineering Controls or Safety Devices**
  - **EXAMPLE -- Interlocks, Machine guards**
- **Provide Cautions and Warnings**
  - **EXAMPLE -- Warning Lights, PA, alarms, signs**
- **Develop Procedural Controls**
  - **EXAMPLE -- Cell entry, test panel safing**
- **Provide Personal Protective Equipment (PPE)**
  - **EXAMPLE -- Gloves, ILC, eye protection**

Hazard Control Maturity Index

$$\frac{\sum_{i}^{n}(RAC)_i(HRP)_i}{n} = HCMI$$

RAC i = Individual Risk Assessment Code of hazard
HRP i = Individual Hazard Reduction Precedence of control
HCMI = Aggregate Hazard Control Maturity Index

RAC levels run 1 (Bad) to 7 (Good)
HRP levels run 1 (Procedural/PPE) to 5 (Eliminated)

Example Typical System:

3 RAC 1 hazards reduced w/Engineering Controls

$$\frac{\sum_{i}^{n}(RAC)_i(HRP)_i}{n} = HCMI \qquad \frac{1(4)+1(4)+1(4)}{3} = 4.0$$

Improve Hazard controls to eliminate 2 RAC 1 hazards --> Improved HCMI

$$\frac{\sum_{i}^{n}(RAC)_i(HRP)_i}{n} = HCMI \qquad \frac{1(5)+1(5)+1(4)}{3} = 4.67$$

Applicable NASA Requirements

NPR 8715.3, "NASA Safety Manual" Rev I. 6/19/02

JPR 1700.1, "JSC Safety and Health Handbook"

Part 2, Worksite Analysis

JSC 17773, "Instructions For Preparation of Hazard Analysis For JSC Ground Operations"

WSI 04SW-0002, "Hazard Recognition & Control"

WSI 25SW-0005, "Process Safety Management of Highly Hazardous Chemicals"

WSI 25SW-0015, "Workplace Hazard Inspection"

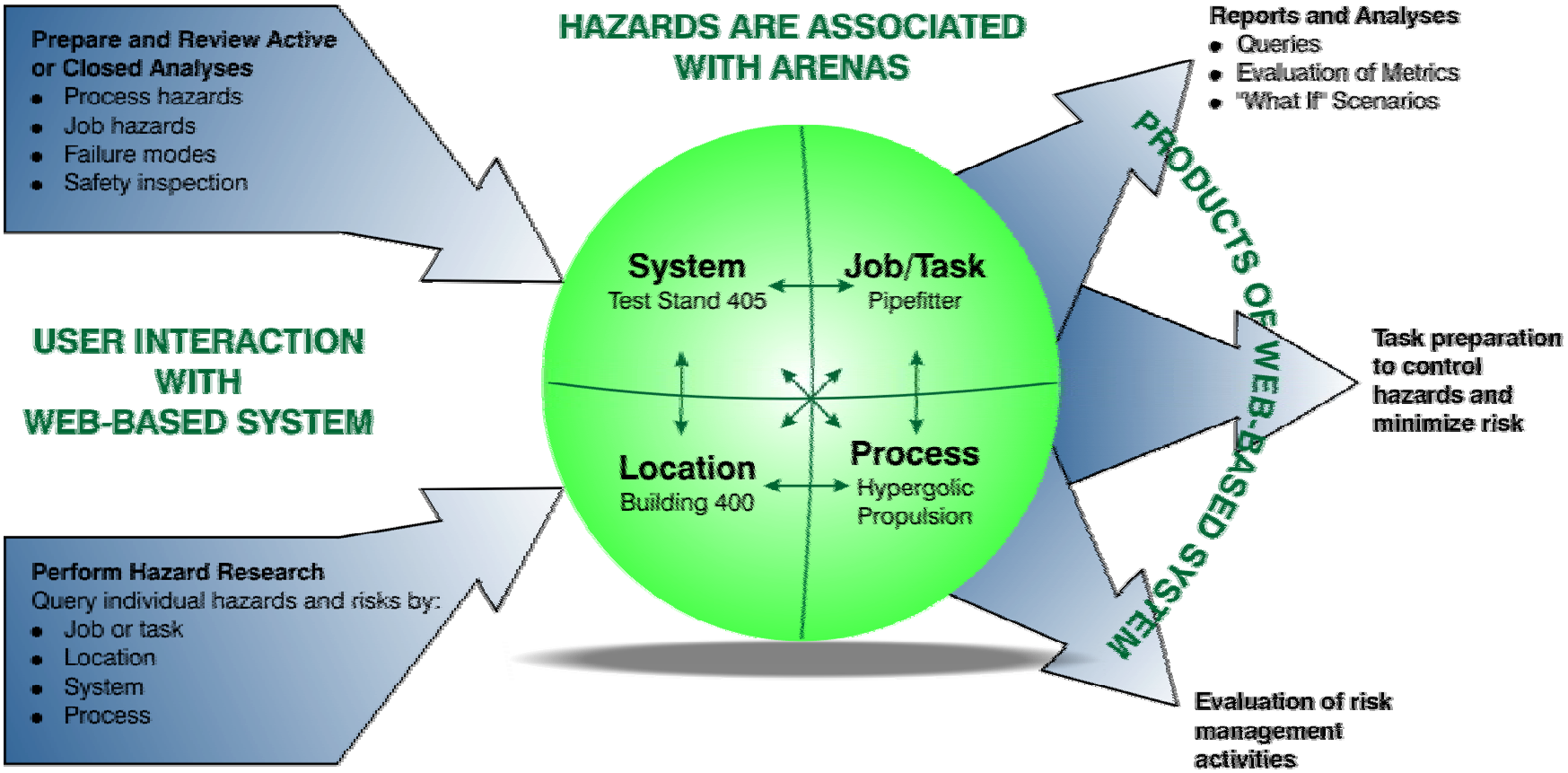
WSI 25SW-0032, "Job Hazard Analysis Instructions"

29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals"

Overview

- **Goals**
  - **Concepts**
  - **Benefits**
- **Business Model – The Theory**
- **Hazard Management System – The Application**

Hazard Management Business Model



User Interface Requirements

- Manage the creation of hazard documentation
- Disseminate hazard information effectively
- Analyze hazards and risks

Meeting the Requirements

- **Documenting Hazards**
  - **HSE performing an inspection**
- **Searching for Hazards**
  - **Boiler Operator dispatched to unfamiliar location**
- **Evaluating the Impact of updated Controls**
  - **Calculate the HCMI at Area 400**

White Sands Test Facility
Hazard Management System

Home || In-Progress Analyses || Inspections || Queries|| Analyses
Admin || My Account || Logout

Inspection Results

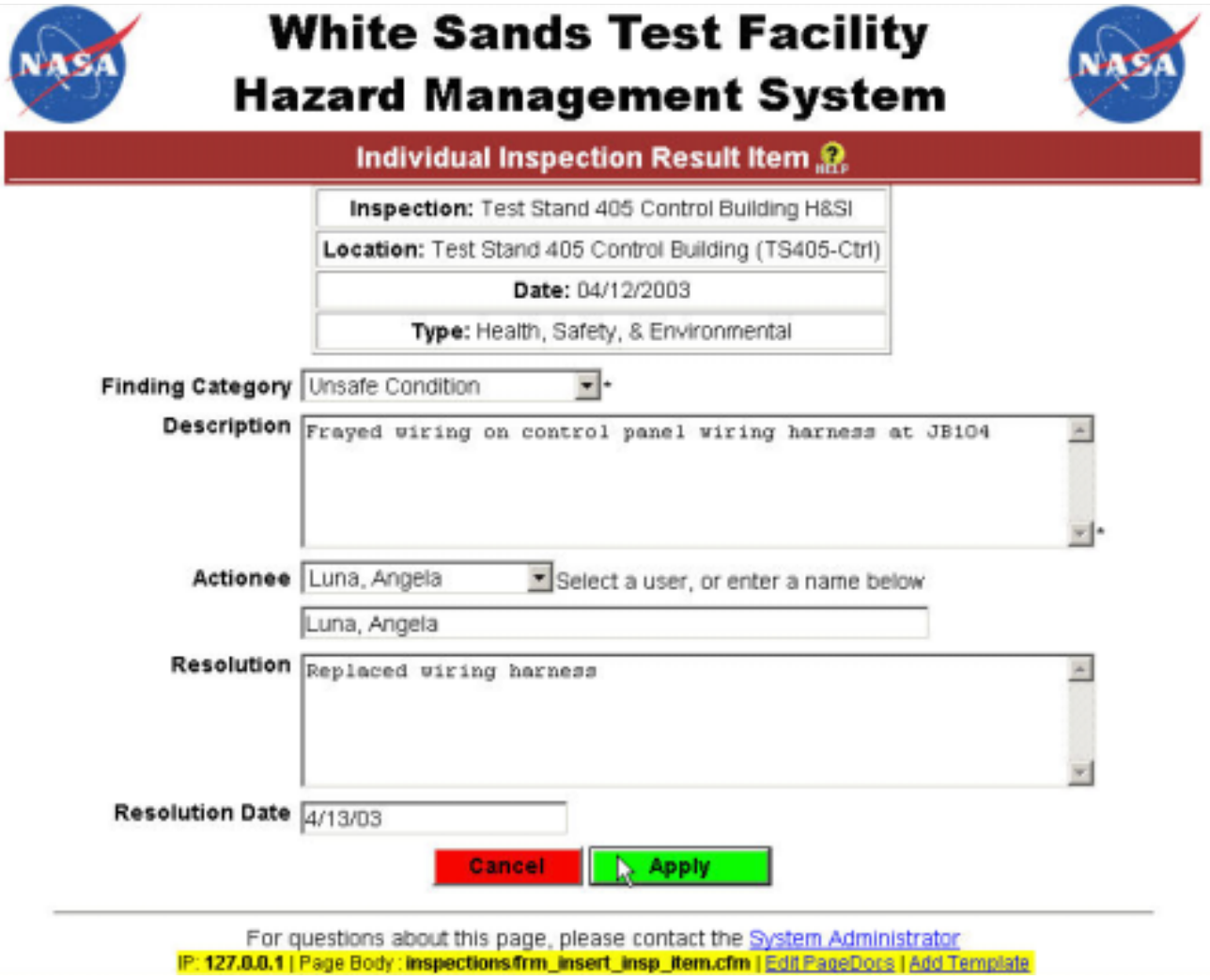
Inspection: Test Stand 405 Control Building H&SI
Location: Test Stand 405 Control Building (TS405-Ctrl)
Date: 04/12/2003
Type: Health, Safety, & Environmental

New Result Item

Item #	Observation Type	Description	Hazard?	Positive Finding?	Assignee	Resolution Date	Actions
3	Observation	Coffee pot remains on overnight	Y		Lillys, Ted	04/13/2003	

For questions about this page, please contact the System Administrator
IP: 127.0.0.1 | Page Body: inspections/dsp_inspection_items.cfm | Edit PageDocs | Add Template

System Administrator's Login Here



White Sands Test Facility
Hazard Management System

Individual Inspection Result Item

Inspection: Test Stand 405 Control Building H&SI

Location: Test Stand 405 Control Building (TS405-Ctrl)

Date: 04/12/2003

Type: Health, Safety, & Environmental

Finding Category Unsafe Condition *

Description Frayed wiring on control panel wiring harness at JB104 *

Actionee Luna, Angela Select a user, or enter a name below

Luna, Angela

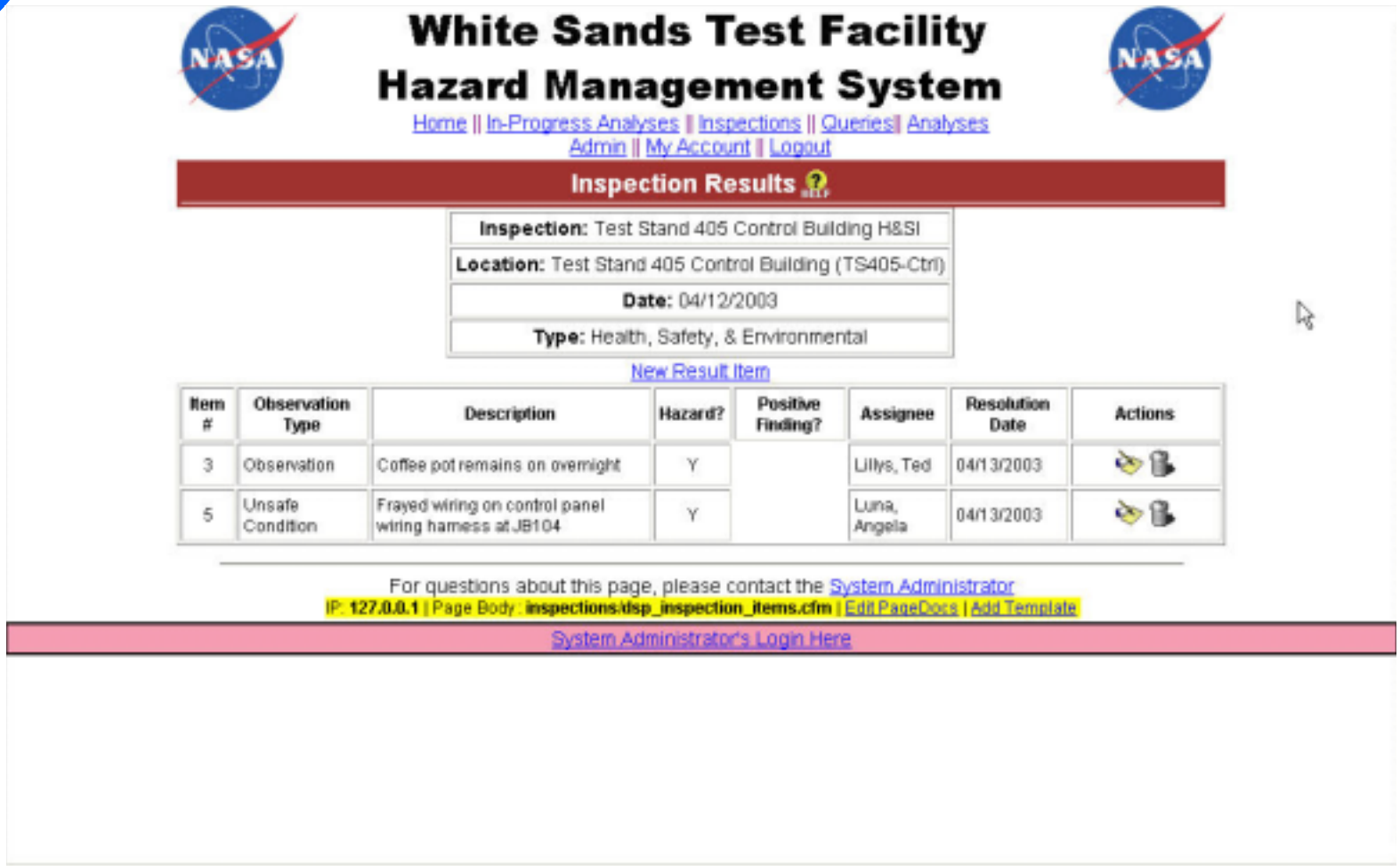
Resolution Replaced wiring harness

Resolution Date 4/13/03

Cancel Apply

For questions about this page, please contact the System Administrator

IP: 127.0.0.1 | Page Body : inspections/frm_insert_insp_item.cfm | Edit PageDocs | Add Template



White Sands Test Facility
Hazard Management System

Home || In-Progress Analyses || Inspections || Queries|| Analyses
Admin || My Account || Logout

Inspection Results

Inspection: Test Stand 405 Control Building H&SI
Location: Test Stand 405 Control Building (TS405-Ctrl)
Date: 04/12/2003
Type: Health, Safety, & Environmental

New Result Item

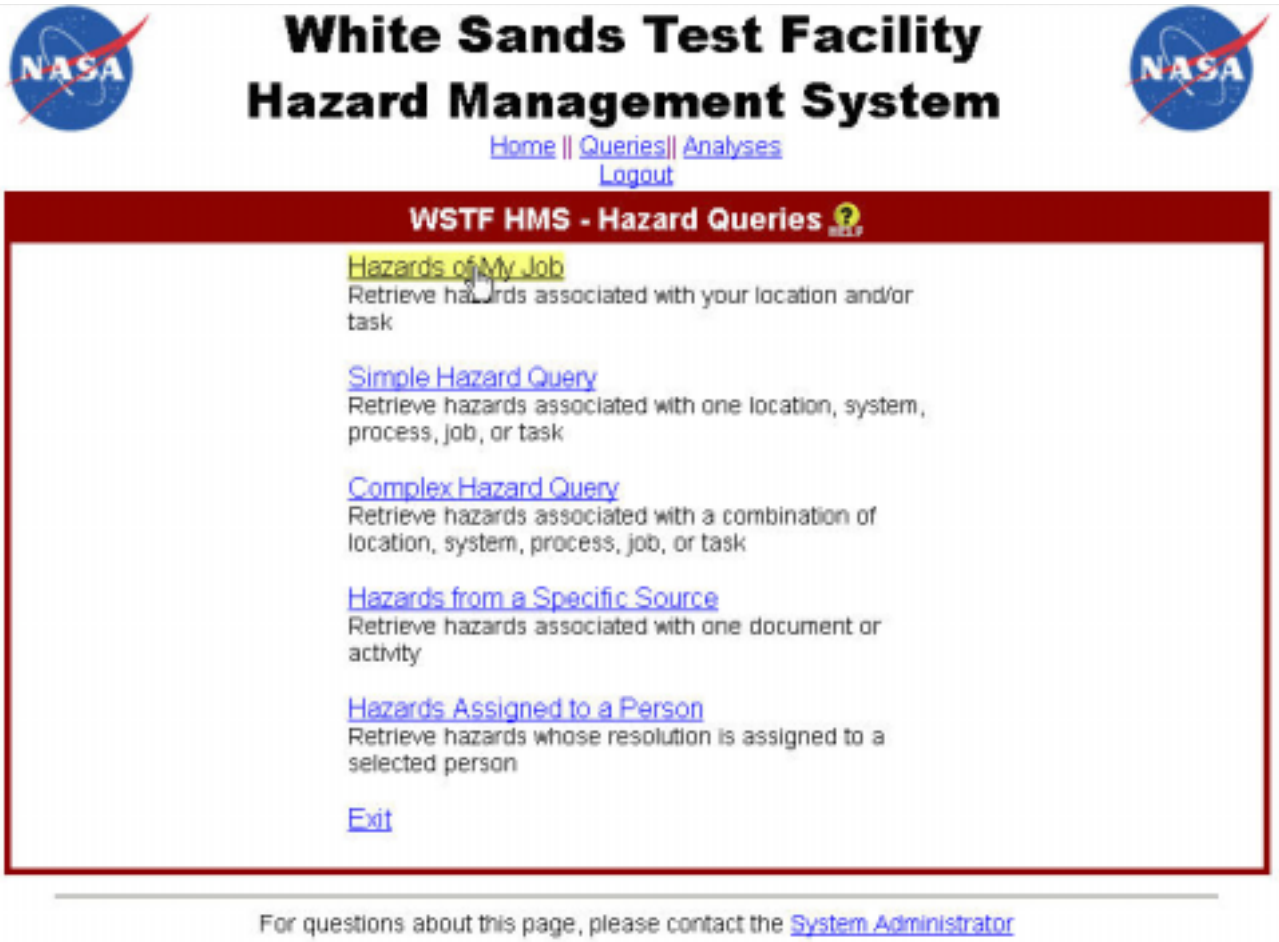
Item #	Observation Type	Description	Hazard?	Positive Finding?	Assignee	Resolution Date	Actions
3	Observation	Coffee pot remains on overnight	Y		Lillys, Ted	04/13/2003	
5	Unsafe Condition	Frayed wiring on control panel wiring harness at JB104	Y		Luna, Angela	04/13/2003	

For questions about this page, please contact the System Administrator
IP: 127.0.0.1 | Page Body : inspections/dsp_inspection_items.cfm | Edit PageDocs | Add Template

System Administrator's Login Here

Meeting the Requirements

- Documenting Hazards
  - HSE performing an inspection
- **Searching for Hazards**
  - **Boiler Operator dispatched to unfamiliar location**
- Evaluating the Impact of updated Controls
  - Calculate the HCMI at Area 400


White Sands Test Facility
Hazard Management System
Home || Queries|| Analyses
Logout
WSTF HMS - Hazard Queries
Hazards of My Job
Retrieve hazards associated with your location and/or task
Simple Hazard Query
Retrieve hazards associated with one location, system, process, job, or task
Complex Hazard Query
Retrieve hazards associated with a combination of location, system, process, job, or task
Hazards from a Specific Source
Retrieve hazards associated with one document or activity
Hazards Assigned to a Person
Retrieve hazards whose resolution is assigned to a selected person
Exit
For questions about this page, please contact the System Administrator

White Sands Test Facility
Hazard Management System
Home || Queries|| Analyses
Logout
Hazards of Concern to Me
I want to know the hazards related to what I do and where I work
I want to find hazards related to this job: Boiler Operator
Show hazards for this task: Pond water sampling/testing
I want to find hazards related to this location: Area 400
Also show hazards that apply to the broader location (For instance, if you select 'Test Stand 400' and check this box, you also get hazards for Area 400.)
Cancel
Show Hazards
For questions about this page, please contact the System Administrator

Return to Previous Page | Return to Query Options Menu

Hazards Associated with Your Selections

Order hazards by (Select)

Hazard	Cause	Results	Controls
Hazards Associated with Pond water sampling/testing			
Water Testing Reagents	Water Testing Reagents	Personnel Injury	Gloves, eye protection, splash aprons shall be worn while testing boiler/DA water, know the locations of the nearest EEW/SS stations, attend training on the proper water sampling procedures as described in WJI PROP-ALT-0033 by a certified boiler technician, review the MSDS of the chemicals used, wash any areas on personnel that have come into contact with the chemicals
Water Treatment Chemicals	Water Treatment Chemicals	Personnel Injury	Gloves, eye protection, splash aprons shall be worn while testing boiler/DA water, know the locations of the nearest EEW/SS stations, attend training on the proper water sampling procedures as described in WJI PROP-ALT-0033 by a certified boiler technician, review the MSDS of the chemicals used, wash any areas on personnel that have come into contact with the chemicals, review mixing procedure as described in WJI PROP-ALT-0146 and WJI PROP-ALT-0149
Propellant combustion products	Propellant combustion products	Personnel Injury	Gloves, eye protection, splash aprons shall be worn while testing pond water, know the locations of the nearest EEW/SS stations, attend training on the proper water sampling procedures as described in WJI PROP-ALT-0150 by a certified boiler technician, receive briefing from Environmental Department on chemicals present in the pond and for emergency procedures, wash any areas on personnel that have come into contact with the chemicals
Waterborne hazards	Waterborne hazards	Personnel Injury	Gloves, eye protection, splash aprons shall be worn while testing pond water, know the locations of the nearest EEW/SS stations, attend training on the proper water sampling procedures as described in WJI PROP-ALT-0150 by a certified boiler technician, receive briefing from Environmental Department on chemicals present in the pond and for emergency procedures, wash any areas on personnel that have come into contact with the chemicals, call Environmental Department to retrieve any animals from the pond
Drowning	Drowning	Personnel Injury	A gated fence is in place around the pond to help prevent accidental drowning, harnesses/lifelines/reards, suspension cables shall be used if access over or around the edge of the pond is required, training shall be provided to personnel working around the pond by the fire department/dispensary on resuscitating a drowning victim
Items Related to Location Area 400			
Trip/Fall	Sidewalks are cracked and uneven	Personnel injury from falling	Repair sidewalk

Return to Previous Page | Return to Query Options Menu

Meeting the Requirements

- Documenting Hazards
  - HSE performing an inspection
- Searching for Hazards
  - Boiler Operator dispatched to unfamiliar location
- **Evaluating the Impact of updated Controls**
  - **Recalculate the HCMI at Area 400**

White Sands Test Facility
Hazard Management System

Home || In-Progress Analyses || Inspections || Queries|| Analyses
Admin || My Account || Logout

Hazard Control Maturity Index Calculation

HCMI for: Area 400 (and sublocations)

Number of hazards retrieved that match search criteria: 27

Number of hazards included in the calculation: 27

HCMI: 10.2

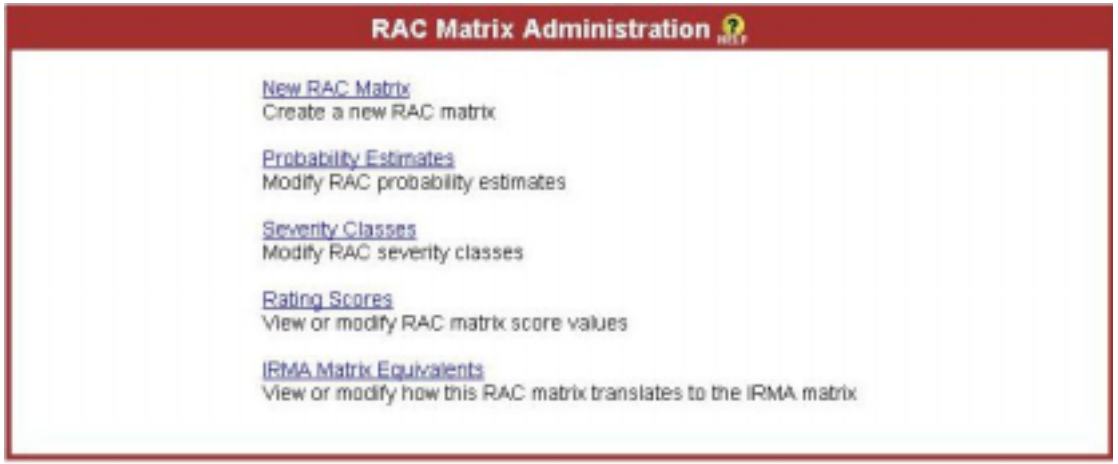
Return to Previous Page

For questions about this page, please contact the System Administrator
IP: 127.0.0.1 | Page Body : analysis/dsp_hcmi_results.cfm | Edit PageDocs | Add Template

System Administrator's Login Here

Other Capabilities

- **RAC Versioning**
- **Ties Local RAC to IRMA RAC**
- **Email Notification**



RAC Matrix

	Likelihood				
Severity	**Likely to occur immediately**	**Probably will occur in time**	**May occur in time**	**Unlikey to occur**	**Improbable to occur**
Catastrophic - Death, several serious injuries or illnesses, or damage over $1,000,000	1	1	2	3	4
Critical - Serious injury or illness, several lost workdays, or damage between $250,000 - $1,000,000	1	2	3	4	5
Marginal - Lost workday, several minor injuries, or damage between $25,000 - $250,000	2	3	4	5	6
Negligible - Minor injury or damage less than $25,000	3	4	5	6	7

IRMA RAC Matrix

	5	Low	Medium	High	High	High

RAC Matrix IRMA Equivalents

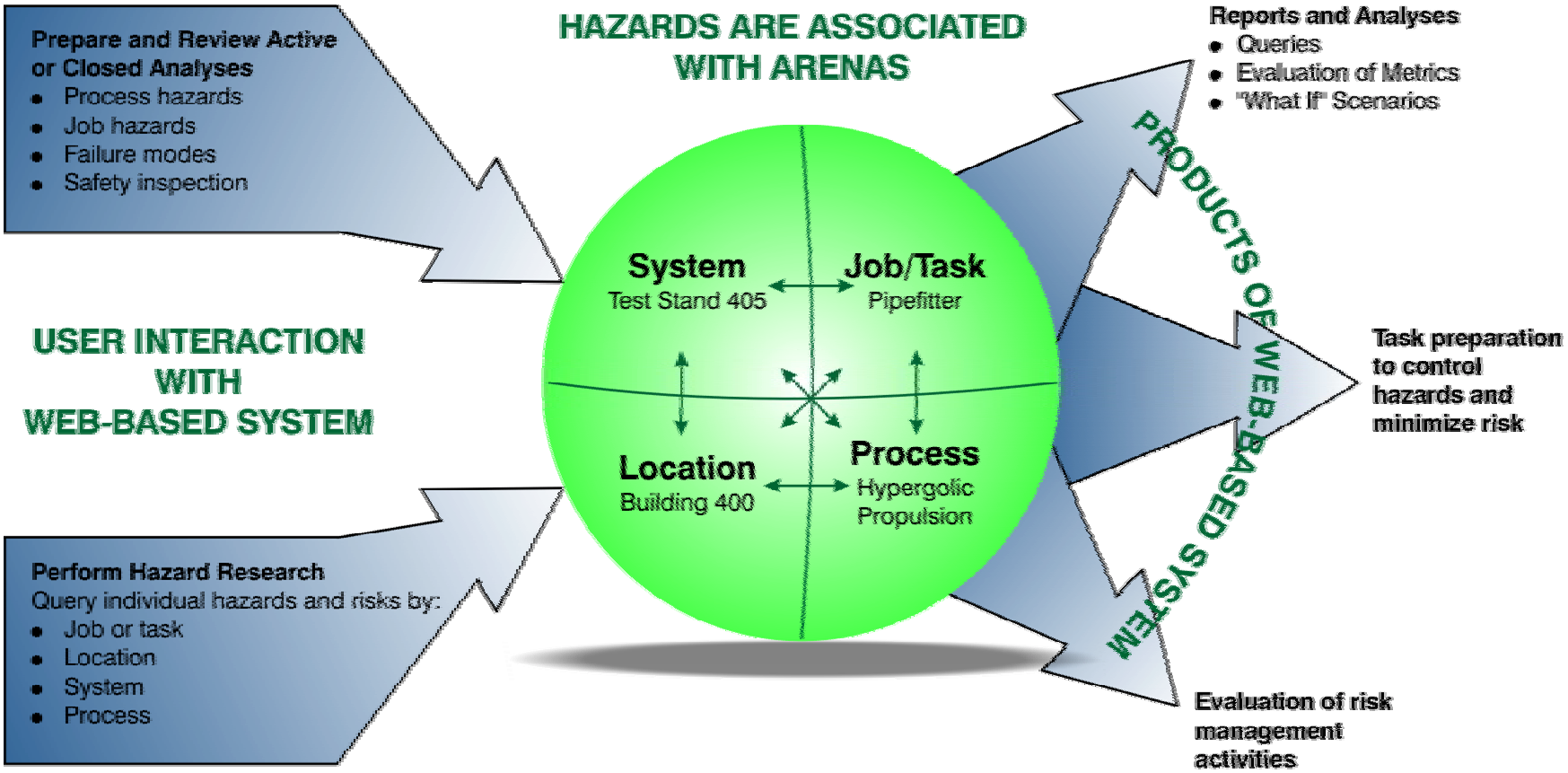
Severity	Probability				
	Likely to occur immediately	Probably will occur in time	May occur in time	Unlikey to occur	Improbable to occur
Catastrophic - Death, several serious injuries or illnesses, or damage over $1,000,000	likelihood: 5 consequences: 5	likelihood: 4 consequences: 5	likelihood: 3 consequences: 5	likelihood: 2 consequences: 5	likelihood: 1 consequences: 5
Critical - Serious injury or illness, several lost workdays, or damage between $250,000 - $1,000,000	likelihood: 5 consequences: 4	likelihood: 4 consequences: 4	likelihood: 3 consequences: 4	likelihood: 2 consequences: 4	likelihood: 1 consequences: 4
Marginal - Lost workday, several minor injuries, or damage between $25,000 - $250,000	likelihood: 5 consequences: 3	likelihood: 4 consequences: 3	likelihood: 3 consequences: 3	likelihood: 2 consequences: 3	likelihood: 1 consequences: 3
Negligible - Minor injury or damage less than $25,000	likelihood: 5 consequences: 2	likelihood: 4 consequences: 2	likelihood: 3 consequences: 2	likelihood: 2 consequences: 1	likelihood: 1 consequences: 1

Submit

IRMA RAC Matrix

Likelihood					
	Low	Medium	High	High	High
	Low	Medium	Medium	High	High
	Low	Medium	Medium	Medium	High
	Low	Low	Low	Medium	Medium
	Low	Low	Low	Low	Medium
Consequences					

Hazard Management Business Model



Demonstration Summary/Q&A

- **Key Concepts**
- **Benefits – Are they transferable?**
- **Are your hazard documentation processes consistent with the model?**
- **Do you have data to populate the model?**

What we got…Products

- Construction and activation of the web-based system.
- Diminished dependence on paper documents.
- Enhanced availability of hazard information for training, awareness, and controls maintenance.
- Consistent identification of hazards, and incorporation of causes and effects, as well as consistent action assignments.

What we want

Beta Release Necessities

- Usability Testing of Alpha
- Development Meetings w/ Centers
- Beta Development, Testing, & Rollout
- 508 Compliance Review
- On-Line Help and User's Guide
- Develop User Training Materials

Develop Connections with Other Databases (e.g., IRMA and IRIS)

Advanced Analysis Features

- Metrics Development & Implementation
- Visualization (e.g., Charts, GIS)
- Advanced Reporting

Center Training, Data Collection, & Implementation