



Understanding the Fire Program Analysis (FPA) Fire Ignition Generator (FIG) IR_005_TP

The Fire Ignition Generator (FIG) models possible fire ignition scenarios on the landscape using historic ignitions from the fire management agencies' systems of record. This paper assumes 200 fire ignition scenarios, but the number of scenarios can be specified as needed.

Each Fire Ignition Scenario (FIS) contains ignitions for one possible way a fire season could occur. Ignition attributes are:

- Day of year (1-365),
- Latitude,
- Longitude,
- Statistical cause (1-9),
- 20-foot wind speed,
- 1-hour fuel moisture,
- 10-hour fuel moisture,
- 100-hour fuel moisture,
- Herbaceous -fuel moisture, and
- Woody-fuel moisture.

Previously, Personal Computer Historical Analysis (PCHA) software accomplished similar functions. In the future, the FPA Project plans to migrate all Fire Event Scenario generation to the FPA enterprise using a three-phase strategy. This means that Fire Planners no longer have to develop this information on their desktop.

FPA is using an enhanced version of the PCHA algorithm. This new algorithm allows for:

- Obtaining “synchronized” weather across all Fire Planning Units (FPU) for any given day.
- Increased accuracy modeling days with more than one ignition.

FPA is following these three phases for implementing the FIG:

1. On the desktop, at the national level, produce “historic-based” FIG.
2. On the desktop, utilize synchronized weather, once it is available.
3. Migrating the FIG to the FPA enterprise.

FPA delivered the first two phases at the end of June 2008.

Phase 1: Produce “Historic-Based” Fire Ignition Generator Data on the Desktop, at the National Level

Phase 1 is an interim solution until FPA receives 500 sets of synchronized national weather from Desert Research Institute (DRI). FPA expects this information in late July 2008.



Understanding the Fire Program Analysis (FPA) Fire Ignition Generator (FIG) IR_005_TP

In Phase 1, FPA will:

- Create a central database of historic (10-year) fires and National Fire Danger Rating System (NFDRS) Remote Automated Weather Stations (RAWS). The data includes information from the five federal agencies and state fires.
- Assign a statistical cause to historical fires without a statistical cause. The cause is determined using a random draw into historical causes within 10 miles during the 10-year period.
- Calculate fuel moistures for all weather observations.
- Determine the closest weather station to each historic fire, and the historic wind speed and fuel moistures linked to the fire.
- Develop a “rolling” 7-day period instead of using sensitivity periods. The assumption in this interim model is that any day of year could have experienced the historic fires and weather as occurred on that exact date, or in the period +/- 3 days (a total of 7).
- No longer use Energy Release Component (ERC) to select fire history. PCHA did a random draw to select fire history from one of the historical years, using ERC to bin the fire history. The new approach avoids the indirection of ERC, and, instead, goes straight to the historical period.

To develop Fire Ignition Scenario #1, each Day of Year (1-365) randomly draws one of the ten historic years, and then one of the 7 dates, within +/- 3 days. The fires and associated weather from that selected date apply to the nation.

For example:

Scenario	Day	Drawn_Date
1	1	01/01/2000
1	2	12/31/2005
1	3	01/06/1998
1	4	01/01/2002
...		
1	365	09/18/2006
...		
200	1	01/03/1999
200	2	12/31/2005
200	3	01/04/2004



Understanding the Fire Program Analysis (FPA) Fire Ignition Generator (FIG) IR_005_TP

Scenario	Day	Drawn_Date
200	4	01/02/2003
200	365	10/28/2001

Table 1: Developing a Fire Ignition Scenario (FIS)

Drawing 365 times from 70 possibilities (10 years, each +/- 3 days) produces 365⁷⁰ combinations.

In addition, “prevented” fires are modeled using preventability factors and historical causes.

Phase 1 offers these advantages over PCHA:

- Weather and fires are synchronized.
- Inter-FPU weather and fires are synchronized.
- Scenarios are created nationally and do not require knowledge of organizational or planning boundaries.

Actions Taken to Develop the FIG prior to June 2008

1. Imported RAWS Stations, Fuel Moistures and Wind speeds data into FPA.
FPA imported data from all RAWS Stations, including 10 years of fuel moistures and wind speed, using data from the GridRAWS2.mbd database and information gathered during the January 2008 Grid Data Validation project.
2. FPA mapped Statistical Cause Codes from their native definitions into the Forest Service Codes. These Codes are:

Statistical Cause Codes	Forest Service Codes
1	Lightning
2	Equipment Use
3	Smoking
4	Campfire
5	Debris Burning
6	Railroad
7	Arson
8	Children
9	Miscellaneous

Table 2: Mapping Statistical Cause Codes to Forest Service Codes



Understanding the Fire Program Analysis (FPA) Fire Ignition Generator (FIG) IR_005_TP

3. Import Historical Fires into FPA.

Historical fire data were imported from each Federal Agency’s fire report system of record database. State fire report data were provided and imported from the National Association of State Foresters with the exception of California, Idaho, and Oregon provided databases. The Fire table in the FIG database includes a Source_ID field that documents the source of each historical fire.

Agency	Data Imported From...	Source_ID
Forest Service (FS)		1
State Fires	National Association of State Foresters NASF_2008_04_01.mdb only when the cause code was < 10, and there was a lat/lon present. Subsequent to this import, California, Oregon and Idaho fires were imported from ignitions.dbf, with a Source_ID of 8.	2
Fish and Wildlife Service (FWS)	FWS_1970_2007.txt, a file created in PCHAffp format, when they had a lat/lon and were shown as “COMPLETE.”	3
Bureau of Indian Affairs (BIA)	BIA_1972-2007_PVHAffp.txt, when they had a lat/lon and were shown as “COMPLETE.”	4
Bureau of Land Management (BLM)	BLM_1972-2007_PVHAffp.txt, when they had a lat/lon and were shown as “COMPLETE.”	5
National Park Service (NPS)	BLM_1972-2007_PVHAffp.txt, when they had a lat/lon and were shown as “COMPLETE.”	6



Understanding the Fire Program Analysis (FPA) Fire Ignition Generator (FIG) IR_005_TP

Agency	Data Imported From...	Source_ID
Bureau of Reclamation (BOR)	BOR_1972-2007_PVHAffp.txt, when they had a lat/long and were shown as "COMPLETE."	7

Table 3: Sources of Imported Fires Data

4. Spatially Assign FPU ID
5. Using Map Objects software, fire records for each FPU_ID was set to the ignition lat/lon in the FPU where the ignition fell.
6. Assign Weather
7. FPA assigns weather to each historic ignition using the closest weather station with available information.
8. Select Ignitions for FPA Modeling

Fire Type/Protection Type (FTPT) values are discussed in the Department of Interior DI1202 and the Department of Agriculture, Forest Service FS570029.

FPA selects ignitions using the following criteria (data (or attribute) field is FPA_Use):

- FPA_Use initialized to FALSE for all ignitions
 - FPA_Use set TRUE if year between 1997-2006
 - FPA_Use set FALSE if Source_ID = 1 (FS) and Ownership_At-Origin NOT 1,2,4
 - FPA_Use set FALSE if Source_ID = 3 (FWS) and FTPT NOT 11,12,13,15,16,19,49
 - FPA_Use set FALSE if Source_ID = 4 (BIA) and FTPT NOT 11,12,13,14,15, 16,19,49
 - FPA_Use set FALSE if Source_ID = 5 (BLM) and FTPT NOT 11,12,13,15, 16, 19,49
 - FPA_Use set TRUE if Source_ID = 5 (BLM) and FTPT 16 AND State AK
 - FPA_Use set FALSE if Source_ID = 6 (NPS) and FTPT NOT 11,12,13,14,15, 16,19,49
9. Create Prevented Ignitions
 For each FPU from 1997-2006, FPA created modeled ignitions for each statistical cause. The number created was the actual count multiplied by the preventability factor for each cause. The results show that modeled fires by statistical cause increased when there is a decrease in prevention program activity. See [Understanding the Fire Program Analysis \(FPA\) Prevention Module PR_014_WP](#) for further information about the FPA Prevention module.



Understanding the Fire Program Analysis (FPA) Fire Ignition Generator (FIG) IR_005_TP

Statistical Cause Codes	Forest Service Codes	
1	Lightning	0
2	Equipment Use	0.15676
3	Smoking	0.1395
4	Campfire	0.17375
5	Debris Burning	0.16125
6	Railroad	0.14125
7	Arson	0.07
8	Children	0.16125
9	Miscellaneous	0.0995

Table 4: Modeled Ignitions for each Statistical Cause

10. Build Model Days

11. For each Model Year (1-200), FPA selected one historic date, through a random draw into a list of historic dates +/- 3 days in any of the years 1997-2006 (70 possibilities). Report Ignitions

FPA calculates and reports ignitions using the following business rules. For example, for year iModelYear:

```
s = "SELECT Model_Year, ModelDays.Day_Of_Year, ModelDays.Fire_Date,
Fires.NWS_ID, Latitude, Longitude, Discovery_Time, Stat_Cause_ID, FPU_ID,
RAWSObs.*"
s = s & " FROM Fires, RAWSObs, ModelDays "
s = s & " WHERE FPA_Use = 1 AND Model_Year = " & iModelYear
s = s & " AND Fires.NWS_ID = RAWSObs.NWS_ID AND ObsDate =
ModelDays.Fire_Date AND Fires.Fire_Date = ModelDays.Fire_Date "
s = s & " AND FPU_ID IS NOT NULL "
s = s & " ORDER BY Model_Year, Fires.FPU_ID, ModelDays.Day_Of_Year,
Discovery_Time "
```

Ignitions are stored in comma separated value (.csv) files. Each file contains 20 model years and is uploaded to ftp://ftp2.fs.fed.us/incoming/wo_fam/Bighorn%20Information%20Systems/ using File Transfer Protocol (ftp).



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Phase 2: Produce Fire Ignition Generator Historical Ignitions with Synchronized Weather

In Phase 2, FPA will:

- Create a central database of historic (10-year) fires and use Fire Weather Scenario data. The data includes information from the five federal agencies and state fire databases.
- Assign a statistical cause to historical fires without a statistical cause. The cause is determined using a random draw into historical causes within 10 miles during the 10-year period.
- Calculate fuel moistures for all weather observations.
- Determine the 8km grid that each historic fire is mapped within, obtain the wind speed and fuel moistures for the Day of Year and Fire Weather Scenario.
- Develop a “rolling” 7-day period this interim model is that any day of year could have experienced the historic fires and weather as occurred on that exact date, or in the period +/- 3 days (a total of 7).

To develop Fire Ignition Scenario #1, each Day of Year (1-365) randomly draws one of the ten historic years, and then one of the 7 dates, within +/- 3 days. The fires and associated weather from that selected date apply to the nation.

Phase 3: Migrating the FIG to the FPA Enterprise

In Phase 3, FPA will:

- Utilize a central database of historic (10-year) fires and use Fire Weather Scenario data. The data includes information from the five federal agencies and state fire databases along with a daily weather observation from the Fire Weather Scenario.
- Assign a statistical cause to historical fires without a statistical cause. The cause is determined using a random draw into historical causes within 10 miles during the 10-year period.
- Calculate fuel moistures for all weather observations in each Fire Event Scenario.
- Determine the 8km grid that each historic fire is mapped within, obtain the wind speed and fuel moistures for the Day of Year and Fire Weather Scenario.
- Seed Bernoulli distribution using historic fires, make random draw for each Day of Year to determine if a fire will occur or not.
- Seed geometric distribution of historic fires, make random draw to determine number of fires on days when fires are drawn to occur.
- Seed Poisson distribution with historic fire start times, make random draw to determine time of day when fires are discovered.
- Create 200 Fire Ignition Scenarios.