

**COMMENTS AND RESPONSES  
FIRE EVENTS - UPDATE OF OPERATING EXPERIENCE,  
1986 - 1999 (DRAFT)**

**I. INDUSTRY COMMENTS AND RESPONSES**

**A. Institute of Nuclear Power Operations (INPO) (C. Brooks)**

Comment: The study is an appropriate use of NPRDS and EPIX data, and the data appears to have been appropriately represented in the analysis.

Response: No response is necessary.

**B. National Electric Insurance Limited (NEIL) (Wayne Sohlman)**

Comment: NEIL reviewed the fire events database material you sent me and find it very complete and functional. The data is organized in a very useful manner. The information will be useful to NEIL for providing insurance coverage to the nuclear industry.

Response: No response is necessary.

**C. Electric Power Research Institute (EPRI) (R. Kassawara)**

This is a review of the draft fire events database published by the Nuclear Regulatory Commission. We have reviewed the letter report and conducted a limited review of the NRC Fire database against the EPRI Fire Events Database (being published in November 2001) for the time period covered by the NRC database [1986-1999].

This review is not intended as a check for completeness and/or accuracy of the records contained in this database or critique of the ignition frequency model and results presented. Also the review is limited to the fire (and not the smoke) events.

General Comments and Responses:

G.C.1. The database in this report provides sufficient information for calculation of fire frequency at various locations in the plant at power or during shutdown. Use of this database for other applications, however, may present a challenge due to limitation of the information, e.g., a narrative explaining the event.

G.R.1. We agree that the database may have limitations for other uses but it does provide useful attributes for other analyses (e.g., duration, means of detection, means of suppression, affect on safety-related trains, effect on power, initiating combustible, component effected, etc.). These attributes were determined from the source narrative of the fire event (LERS and EPIX/NPRDS) or from Database information (EPRI and NEIL).

- G.C.2. Appropriateness of older data to present day plant design and operation depends on the application of data, in this case calculation of frequency of fires. Exclusion of old data requires understanding the changes in plant fire protection design and operation and how they affect the occurrence of fires. Reducing the sample size without knowing why, will only contribute to increased uncertainty in fire frequencies. In addition, an important part of looking at past experience is to understand the effects of plant design and operation changes on occurrence of fires and other elements of the fire protection, i.e., the best lesson is to know what are we doing right and what we can do better.
- G.R.2 We agree that the choice of the sample size is important for calculating fire frequencies for use in risk-informed regulatory applications. Data prior to 1985 was excluded because its frequency was significantly different from more recent experience (not in the same statistical population) and industry design and operation was significantly different after implementation of Appendix R requirements in 1985. This study included post-1985 data to reflect more consistent design and operational characteristics as indicated by the technical assistance request (TAR) memo from NRR for this update. The reason for using data from 1993–1999 in the frequency estimates was that no survey data (EPRI or NEIL) was available during the 1989–1992 period. As survey data constitutes a large portion of the fire events, estimates using data from that period would have greater uncertainties due to data reporting differences. To minimize these uncertainties we chose the 1993–1999 period because it was the most recent set of data with the most consistent data reporting.
- G.C.3. The assertion is made that “The data was more consistently reported” between 1993-1999. This is neither supported by the method used to collect the data (because of plant-to-plant variability) nor by the distribution of events during these years (there are a similar number of fires per operating reactor between 89-92 and 95-99).
- G.R.3. A histogram showing sources of fire events was added to the final report. It shows a significant difference between the 1988-1989 period and the 1989-1992 period. It also shows a similar significant difference between 1989-1992 period and 1993-1999 period. The large difference is mostly due to the number of small fires reported by the EPRI survey (1986-1988) and by the NEIL survey (1993-1999), with no survey fires during the 1989-1992 period. We chose the 1993-1999 period for calculating fire frequencies as it was a continuous period with more consistently reported fire events (Also see response G.R.2 above) but retained all 1986-1999 data in the database.

Specific Comments:

- S.C.1. Item number 311 in the fire events table (referenced as provided by EPRI). EPRI database does not contain an event with similar data and time. However,

the EPRI database does contain an event on 5/10/86 at 02:06, which has a similar description.

- S.R.1. We agree, the item is incorrect and should be 5/10/86, not 5/10/96. This was corrected in the fire event database.
- S.C.2. Item number 336 in the fire events table (referenced from EPIX). We have been unable to find this event in the EPIX database with the information provided here.
- S.R.2. We agree. The item was deleted. The correct fire event is presently listed in the database as LER 318/95005, dated 05/24/95.
- S.C.3. Section 2.2, 2<sup>nd</sup> paragraph, 3<sup>rd</sup> line. The version of the EPRI database published in NSAC-1781 covers fire events between 1986-1998, rather than 1986-1988.
- S.R.3. The 1986-1988, plant survey data was that portion used for this update (1986-1999), not the 1968-1988 total data. However, the text was clarified in the final report to show that the 1986-1988 portion of the EPRI 1968-1988 data was used in the update.

## **II NRC Staff Comment and Responses**

### **A. NRR/DSSA/SPLB (D. Frumkin)**

- C. 1. In a presentation at the NEI Information forum, Bijan (Najafi) of SAIC, representing EPRI was discussing the fire events data from NEIL. He claimed that 1/3rd of NEIL plants did not provide any fire information and that 9 plants provided 2/3rds of the fire information which was provided. Were you aware of this? It is figured into the uncertainty in (your) study?

I thought that NEIL was collecting a fairly complete record, this is not the case. They seem to capture about 10% of the fires.

- R.1. We agree that NEIL survey for fire events was reported for 68 plants, with 41 plants (38%) not reporting. NEIL survey fire events (111) accounted for 66% of fire events included in the fire events database for the 1993-1999 period.

As discussed with NRR and RES cognizant statistical staff, an extrapolation for postulated small fires was developed for the 41 nonreporting plants and was included in the fire frequency calculations. Section 3.2 and Appendix A describe the methodology and results. These calculations also include quantification of uncertainty.

### **B. NRR/DSSA/SPSB (J. S. Hyslop)**

- C.1. Table A should be 93-99, not 86-99 as currently identified.
- R.1. Agreed. Table will be changed.

- C.2. It should be clarified if frequencies in Table A are for rooms with redundant trains or single train. Or if (the plant has) a single room for multiple units. This is appropriate for CSR, CR, SWGR at least.
- R.2. Appendix A, section A-2.1 was added to discuss apportioning the plant location fire frequencies when there is more than one area in the plant, such as switchgear rooms and battery rooms.
- C.3. You indicate that old data (65-85) (is) no longer representative of current design, configuration, and operating characteristics due to implementation of Appendix R. Is this only for transient fires, or for fires from fixed sources as well? I would imagine that a large percentage of fires are from fixed sources in the old database. Did appendix R decrease fires from those sources?
- R.3. No analysis of data prior to 1985 was performed in this report as it was outside the update period requested by NRR in their TAR. Data in the previous report (AEOD/S97-03) included fires from fixed and transient sources. There has been a decrease in fire frequency compared to the pre-Appendix R period (1965–1985).

**C. RES/PRAB (M. Cunningham)**

C.1. The report and accompanying database provide important information that will be useful to a number of users, including the Office of Research's ongoing fire risk research programs.

R.1. No response is necessary.

C.2. The assertion in section 2.1 of the report (shown below), which justifies why the database update does not address events over the 1965-1985, period, may be plausible. However, since data was available for this period and later, a statistical test should be performed to support this assertion.

“The first time period 1965-1985 was prior to the implementation of 10 CFR 50 Appendix R plant modification and procedures. It is not included in the this update because it is no longer representative of current design, configuration, and operating characteristics of the fire protection system”

R.2. The reference to the 1965–1985 period was change<sup>d</sup> in section 1.2 Background to read: “ The data for the first period, 1965–1985 are not included in this update. This period was prior to the implementation of 10 CFR 50 Appendix R plant modifications and procedures.” The statement in the draft report (see comment C.2., above) has been deleted from the text. See the response to G.C.2, below for additional discussion of the rationale for the selection of the 1993–1999 period for fire frequency estimates.

- C.3. The report should list the different reporting criteria used by each of the different data sources (LERs, EPIX, EPRI database, NEIL) used to develop the database.
- R.3. The report lists the attributes in the fire events database (Appendix B, Table B-1) that we used, as agreed on to meet the technical assistance request for an update of the initial study. The information for these attributes was obtained from the data sources, including LERs, EPIX/NPRDS, and NEIL. Fire events from LERs and EPIX/NPRDS were identified through a macro word search ("fire") of the narratives and then screening out non-fire events (fire protection, fire barrier, fire watch, etc.). Fire event data in the EPRI and NEIL databases was from specific fire event surveys with fields that characterize the fire event attributes. The NRC has access to the proprietary EPRI and NEIL databases and they can be made available to NRC staff as needed, but are not a specific part of the report. Appendix B, Table B-3 was added to include definitions of fire event terms such as fire duration, fire extent, fire suppression method, plant fire location, etc. used in the study. These terms were included in the review of all of the fire event sources.
- C.4. The database field EXTENT/DUR(min) appears to be one where the author's judgement was important. The report should describe the criteria used to provide entries for that field.
- R.4. Analyst judgement was important in some cases where the data was not specific regarding the extent of the fire or the fire duration. Appendix B, Table B-3 was added to define the terms Fire Extent and Fire Duration used for this assessment.
- C.5. Table 2 in Appendix 1 needs some minor cleanup (e.g., see the) entry corresponding to EVENT DATE). More importantly, are the COMP EFFECT and TRAIN EFFECT fields mislabeled? Based on the database entries in these fields, they could refer to the affected components/trains. Or do they indicate that the referenced components/trains were lost. Some additional explanation of these entries is needed.
- R.5.
- a. The Event date was corrected to delete word "same."
  - b. The Comp Effect is the Component Effected. Appendix B, Table B-2 was changed to clarify that the component "Effect" is component effected and ("lost"). A similar change was made to clarify that the Train Effect is the train effected ("lost").
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- C.6. Given the reports statement that a "Jeffreys prior was used," it appears that the mean fire frequencies were developed using a Bayesian Updating Process. The report should also provide key percentiles of the resulting posterior distribution (e.g., the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup>).

- R.6. An amplification of the methodology for calculating fire frequencies was added to the text. The lower bound (5<sup>th</sup>), mean, and upper bound (95<sup>th</sup>) was included for the Bayes 90% interval.
- C.7. The following potential report additions would be useful to a variety of readers:
- a. A histogram showing the total numbers of fire events for each year.
  - b. A histogram showing the number of fire events collected from each source (LERs, EPIX, EPRI, NEIL for each year).
  - c. A description (including an example) of the form of the data that can be collected through EPIX.
  - d. The database structure (fields and the function) used in the EPRI database.
  - e. The NEIL event reporting form (including the supplement).
- R.7. a. A histogram for total, power operation, and shutdown for the 1986-1999 period was added to the final report.
- R.7.b. For the histogram (r.7.a., above), the number of fire events for each year was shown as a stacked cluster of source (LER, EPIX, EPRI, NEIL) Fire events.
- R.7.c.,  
d., &e. Response to comment 3., above identified the sources of data and how they were used to develop the updated fire events database for this study. References to NRC correspondence with INPO, EPRI, and NEIL were added to the text Reference Section 4.0. In addition a footnote was added to Section 2.1 Data Sources that the EPIX database is available for EPIX users and the EPRI and NEIL databases can be made available to NRC staff through RES/OERAB.