

May 7, 1997

SECY-97-101

FOR: The Commissioners

FROM: L. Joseph Callan /s/  
Executive Director for Operations

SUBJECT: PROPOSED RULE, 10 CFR SECTION 50.76, "REPORTING RELIABILITY AND AVAILABILITY INFORMATION FOR RISK-SIGNIFICANT SYSTEMS AND EQUIPMENT"

PURPOSE:

To provide the Commission with the staff's recommendation for obtaining reliability and availability data for key safety systems.

BACKGROUND:

From 1991 to 1994, the Nuclear Regulatory Commission actively pursued with industry a voluntary system to obtain the reliability data needed for risk-informed applications. These discussions were held first in meetings of a NRC/industry task force that made recommendations to the Institute of Nuclear Power Operations (INPO) on revising the Nuclear Plant Reliability Data System (NPRDS) to obtain these data and later in meetings on a proposal by the Nuclear Energy Institute (NEI) that INPO's Safety System Performance Indicator (SSPI) data serve as a source of reliability and availability data. No action was taken on the recommendations to modify NPRDS to provide data for probabilistic risk assessment (PRA) applications. After failing to achieve a mutually acceptable program for providing reliability and availability data, on October 19, 1994, James M. Taylor approved

Contact:  
Dennis P. Allison, AEOD  
(301) 415-6835

the initiation of rulemaking to require that licensees submit reliability and availability data to the NRC. In its directions to the staff in a staff requirements memorandum (SRM) dated October 24, 1995, responding to SECY-95-215 and a SRM dated June 28, 1995, responding to SECY-95-129, the Commission (1) approved the proposed rule, and (2) stated that the staff should continue to work with industry on voluntary submittal of reliability data, under a program that will meet the needs of all parties. The proposed rule was published in the *Federal Register* for public comment on February 12, 1996; the draft regulatory guide was noticed for comment in the *Federal Register* on May 2, 1996; and a public meeting was held on June 4, 1996.

As discussed in the Statement of Considerations (SOC) for the proposed rule, the NRC needs a source of scrutable, plant-specific reliability and availability information to improve the NRC's oversight capability with respect to public health and safety by focusing the NRC's regulatory process in a risk-informed manner. Plant-specific reliability and availability information would be used in plant-specific PRA models to develop indicators of plant performance that are more closely related to risk than those currently in use. Among other benefits, these indicators would improve the process for selecting plants for focused attention at NRC senior management meetings. Plant-specific reliability and availability data also would be used to guide plant inspections towards more risk-significant systems and components where their level of performance may be of concern. Credible reliability and availability data, collected in a database available to both NRC and the industry, would also be used by licensees to implement several aspects of risk-informed regulation. These include applications for plant-specific licensing actions (e.g., technical specification changes to address plant changes, risk ranking for graded quality assurance and risk-informed testing and inspection). In addition, the data would be useful to industry in the evaluation and goal setting activities of the maintenance rule and to the NRC in monitoring maintenance rule implementation. Other uses of data discussed in the SOC include: (1) NRC staff reliability analyses of selected risk-significant systems and components, (2) prioritizing generic safety issues and deciding whether new requirements are warranted to resolve the issues, and (3) improvements to NRC's plant-specific accident sequence precursor analyses.

The public comment periods ended on June 11, 1996, and July 5, 1996, for the rule and the regulatory guide, respectively. Many public comments were received. Major issues include assertions in industry comments that: (1) costs are underestimated, (2) benefits are overestimated, (3) the rule would be overly burdensome, (4) the rule would be premature, and (5) the rule is not needed.

In October 1996, INPO provided NRC a sample of SSPI data to evaluate a proposed voluntary alternative to the rule, and a revised Memorandum of Agreement (MOA) between INPO and the NRC was signed on December 24, 1996 providing NRC with access to SSPI data. The revised MOA describes how INPO would provide SSPI data to the NRC, and the procedures and circumstances under which NRC could disclose data outside the NRC. On January 30, 1997, the staff met with NEI, INPO, and industry personnel to discuss its evaluation of the sample data. Aside from a few specific exceptions, the staff was unable to make meaningful estimates of demand unreliability or operating failure rates from SSPI data. However, SSPI does provide information for estimating unavailability. In response to that meeting, industry proposed making modifications to the INPO Equipment Performance and Information Exchange (EPIX) System to address issues raised by the staff. This new system will replace the NPRDS. Attachment 3 provides a summary of the suitability of the data from the voluntary proposal for estimating reliability and availability related parameters.

In a letter dated March 21, 1997, Mr. Ralph Beedle of NEI provided additional information including a program description for EPIX. The letter indicated industry's commitment to work with the NRC staff to ensure that data requirements are addressed in the most practical and efficient manner. In response to the issues identified at the January 30 meeting, EPIX would include additional information on demands and operating hours for key components in systems within the scope of SSPI.

The proposed voluntary alternative is based on the EPIX system which provides component failure and demand data for a broad scope of systems and the SSPI system which provides train unavailability data for systems within its scope. Attachment 1 provides a brief summary of the basic data that would be provided by industry under the voluntary alternative. The NRC staff would also use Licensee Event Reports (LERs) which provide actual and spurious demand data for engineered safety feature systems, monthly operating reports and other information to construct a more complete reliability database, available for general use. The staff has now completed its evaluation of the proposed voluntary alternative to the rule as modified by the March 21, 1997, letter from NEI.

#### DISCUSSION:

The staff considered two primary questions. The first involves the question of whether the voluntary approach is capable of providing the needed data. The second involves consideration of what action should be taken with respect to the rulemaking. The following section discusses the advantages and disadvantages of the voluntary approach. It forms the basis for resolving the first question by discussing how the voluntary approach would meet the Commission's goals. The next section discusses how the staff might proceed with respect to rulemaking in light of the advantages and disadvantages noted in the evaluation of the voluntary approach.

#### Staff Evaluation of the Voluntary Approach

In its evaluation, the staff considered a number of advantages and disadvantages of the proposed voluntary alternative, including cost, schedule, and other factors discussed below. The most important factor was to determine whether the reliability and availability parameters required in PRA models and applications can be estimated using the data supplied by industry under the proposed voluntary alternative along with other information available to the NRC. Attachment 2 identifies the PRA parameters and associated data elements. Attachment 3 shows the additional work the staff would need to do to construct a database that can be effectively used in risk applications. With the additional efforts noted in Attachment 3, the staff concludes that these parameters can be estimated and the NRC can construct a reliability database that reflects the parameters needed for effective use in risk-informed applications. The NRC staff effort necessary to process the voluntary data into a coherent reliability and availability database is estimated to be about the same as for collecting and processing data under the proposed rule. The Office of AEOD has budgeted this activity and in either case, would be responsible for its implementation.

There are three significant advantages to the voluntary approach: (1) lower cost for industry, (2) earlier data availability, and (3) industry support. Much of the information in EPIX (tracking component failures and estimating component demands) is designed to assist utilities in implementing the maintenance rule. Thus, the staff estimates a relatively low additional cost to licensees if the NRC accepts the voluntary alternative. On the other hand, imposition of a rule, even a rule that is redrafted to minimize costs based on what is now known about SSPI and EPIX,

would involve substantially greater costs. The difference is estimated to have a present value on the order of \$50 million.

Voluntary data would be available earlier than data required by rule. Utilities began collecting data as of January 1, 1997 to be put into EPIX when the software is available. Voluntary data would be provided to NRC in early 1998. By contrast, the NRC would not receive data required by rule until mid-1999 at best (assuming six months to publish a final rule, six months to set up a program and begin collecting data, and one year to collect data for the first report). The voluntary alternative was proposed by industry representatives and would allow industry to use its preferred method of providing data and, thus, is considered to have industry support. Finally, the voluntary alternative is linked to the maintenance rule in that much of the data provided in EPIX has been designed to assist licensees in implementing the maintenance rule.

Also, under the voluntary proposal, data would be entered into a well-structured and efficient menu-driven database system that should provide more consistent failure reporting than previously (i.e., in NPRDS). In addition, the voluntary alternative would provide component level failure reports for many more components than would be covered by the rule. Among other advantages of the increased number of failure reports is the larger population of data available for estimating common cause failure parameters which are a key influence on risk for highly redundant systems and components.

The NRC staff will participate in the EPIX users group and will work with INPO to develop a system that will meet NRC and industry's needs for reliability data now and in the future. The voluntary approach is expected to evolve as industry and the staff gain more experience in risk-informed applications. By contrast, a rule would need to be complete at the onset, or require rulemaking to make changes as experience is gained with risk-informed applications.

Now that the industry has offered to provide much of the needed data on a voluntary basis, the justification for a rule would need to rest on the incremental benefits of a rule vs a voluntary approach (rather than the total benefits as was the case at the proposed rule stage).<sup>1</sup>

The key disadvantages to the voluntary alternative relate to (1) less specific data than would be reported under the proposed rule and (2) less assurance of complete and accurate reporting. Information not currently specified in the EPIX system includes: (1) the number of valve-stroke tests vs valve-flow tests, (2) the number of EDG manual starts (and manual loads) vs automatic starts (and automatic loads) and (3) the number of return-to-service tests vs other tests. For components in systems outside the scope of SSPI, planned unavailable hours will not be provided<sup>2</sup>. In addition, running hours for some components such as service water pumps and component cooling water pumps will be provided as one-time estimates. Although these data should be readily available, industry proposals have not included them in the voluntary approach.

Nonetheless, the staff has evaluated these limitations and has determined that methods are

---

<sup>1</sup> At the proposed rule stage, the Office of Management and Budget stated that (1) the proposed rule was not approved and (2) the NRC should address all of the public comments when it submits the final rule.

<sup>2</sup> EPIX provides failures, estimated demands and unplanned unavailable hours, for structures, systems and components determined to be of high safety significance in implementing the maintenance rule, but does not provide planned unavailable hours.

available to overcome these problems and to make meaningful and reasonable estimates of the basic PRA parameters. Attachment 3 identifies the limitations in the voluntary data and compensatory measures. These would, necessarily, introduce some additional uncertainty and probably a conservative bias in some of the derived parameter estimates. The NRC would work with INPO and industry representatives to improve EPIX in the future as more risk-informed applications that use the data are undertaken.

NRC's assurance of the quality and completeness of the data would be somewhat limited with the voluntary approach. In the past there have been performance problems with voluntary reliability data systems. However, the EPIX coupling to the maintenance rule and the highly structured nature of EPIX failure reporting provide some reason to expect a higher degree of completeness and accuracy in reporting.

The public availability of SSPI data (unavailability data) are covered by the December 24, 1996, MOA. The EPIX data are expected to be handled in a similar manner as NPRDS data covered by the MOA. That is, the plant-specific raw data provided by industry would be publicly available only in specific circumstances such as a need to publish data in connection with a regulatory decision. However, analysis results, such as generic and plant specific equipment reliability estimates, based on the data can be made publicly available.

#### Staff Considerations Relating to Rulemaking

The staff considered several possible approaches with respect to rulemaking. These included (1) rejecting the voluntary approach and proceeding with rulemaking, (2) accepting the voluntary approach with different actions relating to rulemaking and (3) continuing discussion of the voluntary approach.

The Commission could completely reject the industry's proposed voluntary approach and go forward with the currently proposed rule. It should be recognized that the proposed rule provides a good definition of the data elements that are needed but does not encompass the full set of high safety significant systems as defined during implementation of the maintenance rule. A variation would be to include data for additional systems before completion of rulemaking. This modification might require another round of public comment. Among other things, proceeding with rulemaking would delay the flow of reliability information that we expect to obtain from the voluntary approach, on the order of 1-2 years if the currently proposed rule is issued essentially as is or 2-3 years if the rule is modified to such a degree that another round of public comment is warranted.

The Commission could accept the industry's proposed voluntary approach, withdraw the proposed rule, evaluate the data as it accumulates, and work with industry to make improvements over time. An alternative would be acceptance of the voluntary approach on an interim basis, without withdrawing the proposed rule. If, after a 2-3 year trial period, it is found that there are serious shortcomings in the voluntary approach, then the proposed rule would be revisited and converted to a final rule. This was considered but rejected because it was felt that there would be little salvage value to the proposed rule. Undoubtedly any new rule would be so different in tone and content that it would be necessary to, in essence, start over and renotice the rule. Any required rulemaking is expected to be focused on the shortcomings experienced, and not on the predominant areas where the voluntary approach would be working.

Lastly, there is an option to reopen the discussions with industry. Under this option the Commission would neither accept nor reject the industry's proposed voluntary approach or the rulemaking option. Instead, NRC staff would continue to interact with NEI and INPO to remedy some of the shortfalls discussed in the evaluation of the voluntary approach, such as the need for work-arounds. This option was not pursued because the staff thought it would get a reasonable flow of vital information in a timely manner under the voluntary industry approach. The staff also believes that, as it works with the data, shortfalls and obvious inadequacies can be discussed with industry and changes and improvements can be obtained.

#### RESOURCES:

As previously stated, the NRC staff effort necessary to process the data into a coherent reliability and availability database is estimated to be about the same as for collecting and processing data under the proposed rule. AEOD's FY 1997 budget and FY 1998 budget request include sufficient resources to implement the actions discussed in this paper. Resources for FY 1999 and beyond will be addressed during the upcoming budget formulation process.

#### COORDINATION:

The Office of the General Counsel (OGC) has no legal objection to this paper. The Office of the Chief Financial Officer has no resource-related objection to this paper. The Office of the Chief Information Officer has reviewed this paper for information technology and information management implications and concurs.

RECOMMENDATIONS:

The staff recommends that the Commission accept the voluntary approach proposed by NEI. The main advantages of the voluntary alternative (i.e., the cost, schedule, and industry support), outweigh the disadvantages. As stated in the NEI letter of March 21, 1997, "Given the evolving nature of industry data needs, continued dialogue with and feedback from NRC and industry users are essential in assuring the dynamic nature of EPIX as it effectively meets its specified needs.... The industry is committed to working with the NRC staff to ensure that data requirements are addressed in the most practical and efficient manner." The staff would continue to work cooperatively with INPO and industry representatives to improve the content of this voluntary data in the future. The staff plans to negotiate appropriate revisions to the MOA to include EPIX data.

L. Joseph Callan  
Executive Director  
for Operations

Attachments:

1. Brief Summary of Data to be Provided by Industry Under the Voluntary Approach
2. Identification of PRA Parameters and Associated Data Elements
3. Evaluation of Reliability and Availability Information

BRIEF SUMMARY OF BASIC DATA PROVIDED BY INDUSTRY  
UNDER THE VOLUNTARY APPROACH<sup>3</sup>

Data Needed	Data Provided for Systems in SSPI Scope	Data Provided for Other Systems of "High Safety Significance" Under the Maintenance Rule
Failures	Failures provided	Failures provided
Demands – Test	Estimated average test demands	Estimated average total demands (one-time estimate)
Demands – Non-Test	Counted non-test demands	
Demands by Type	Not broken down into types beyond test vs non-test	Not broken down into types at all
Run Times	Actual operating hours	Estimated average operating hours (one-time estimate)
Unplanned Unavailability	Unplanned unavailable time for each repair <sup>4</sup>	Unplanned unavailable time for each repair
Planned Unavailability	Planned unavailable hours for train for each month (from SSPI)	No
Unavailability Due to Support System	Unavailable hours for each train for each month (from SSPI)	EPIX provides <u>unplanned</u> unavailable times directly for components in support systems, but <u>not planned</u> unavailable hours
Concurrent Unavailability	Ability to screen for significant occurrences	No

<sup>3</sup> Unless otherwise noted, data are provided by EPIX on a component basis.

<sup>4</sup> From time of failure discovery to time of return to service.

## IDENTIFICATION OF PRA PARAMETERS AND ASSOCIATED DATA ELEMENTS

The following PRA equations indicate the parameters that need to be estimated:

- Equation for the total unavailability of standby equipment.

$$Q_T = q_d + \frac{1}{2} \lambda_s t_i + U$$

where:  $q_d$  = demand failure probability (failure to start or change state)  
 $\frac{1}{2} \lambda_s t_i$  = equipment unavailability due to failure from environmental stresses  
 $U$  = equipment unavailability due to out of service for repair or maintenance  
 $t_i$  = test interval

- For operating equipment such as pumps, EDGs, or control valves, a term is added to the equation to represent failure during the mission time

$$Q(t) = 1 - e^{-\lambda(r)t(m)}$$

where:  $\lambda(r)$  = the running, or operating, failure rate  
 $t(m)$  = the mission time

- Data from a reliability database are needed to estimate  $q_d$ ,  $\lambda_s$ ,  $U$ , and  $\lambda(r)$ . The terms  $t_i$  and  $t(m)$  are unique for each application, and are determined by plant operations and design characteristics.

To estimate  $q_d$ , the number of failures to start or change state ( $N_f$ ) and the number of demands on the component to start or change state ( $N_d$ ) are needed.

$$q_d = N_f / N_d$$

To estimate  $\lambda_s$ , the number of failures due to environmental stresses ( $N_{sf}$ ) and the component on-line time ( $t_s$ ) are needed.

$$\lambda_s = N_{sf} / t_s$$

To estimate  $U$ , the planned outage time ( $t_{plan}$ ), the unplanned outage time ( $t_{unp}$ ), and the component time on-line ( $t_s$ ) are needed.

$$U = (t_{plan} + t_{unp}) / t_s$$

To estimate  $\lambda(r)$ , the number of failures during operation, or while running ( $N_{rf}$ ), and the accumulated run time ( $t_r$ ) are needed.

$$\lambda(r) = N_{rf} / t_r$$



EVALUATION OF RELIABILITY AND AVAILABILITY INFORMATION

The following table indicates the kinds of efforts needed to compensate for weaknesses in the voluntary data in estimating PRA parameters:

PRA PARAMETERS	AVAILABILITY UNDER VOLUNTARY APPROACH	POSSIBLE WORK-AROUNDS
$N_f$ (The number of PRA failures, needed as the numerator to estimate $q_d$ )	Available in EPIX on a component basis, <i>including the specific type of demand associated with the failure.</i>	No work-arounds needed.
$N_d$ (The number of valid demands, needed as the denominator to estimate $q_d$ )	For components in the SSPI reporting scope, EPIX will contain total component level demands partitioned as "test" (estimated) and "non-test" (counted).  For components not in SSPI scope, EPIX will contain component level demands, not partitioned by type, and estimated once.	Work-around for SSPI scope components involves obtaining further breakdown of demand type data by: <ul style="list-style-type: none"> <li>● estimating test demands from Tech Specs IST requirements and other requirements</li> <li>● estimating actual and spurious demands from LERs</li> <li>● comparing with demands in EPIX</li> </ul> Work-around for non-SSPI components involves estimating demands as above, and comparing with EPIX estimates.
$N_{st}$ (the number of PRA failures due to environmental stress, needed as the numerator to estimate $\lambda_e$ )	Failures available in EPIX on a component basis using cause coding and supplemental descriptions	No work-arounds needed.

<p><math>t_s</math> (Component standby on-line time, needed to estimate component failure rate, <math>\lambda_s</math>)</p>	<p>The plant state is recorded for all failures in EPIX. Other sources available to the NRC (e.g. monthly operating reports) provide the plants' operational states.</p>	<p>No work-arounds needed.</p>
<p>PRA PARAMETERS</p>	<p>AVAILABILITY UNDER VOLUNTARY APPROACH</p>	<p>POSSIBLE WORK-AROUNDS</p>
<p><math>t_{plan}</math> (Component planned outage time, needed to estimate component outage unavailability, U)</p>	<p>For components in SSPI scope, train level planned outage time is recorded. EPIX contains identifiers that relate components to SSPI trains.</p> <p>For components not in the SSPI scope, planned outage time is not available in EPIX or SSPI.</p>	<p>For components in SSPI scope, no work-around needed.</p> <p>For components not in the SSPI scope, the work-around is to develop estimates of planned outage time considering information such as:</p> <ul style="list-style-type: none"> <li>● planned outage of other systems</li> <li>● surveying plant practices</li> <li>● relationship of planned and unplanned outages</li> <li>● fraction of unplanned demands that occur during planned outages</li> </ul>
<p><math>t_{unp}</math> (Component unplanned outage time, needed to estimate component outage unavailability, U)</p>	<p>EPIX contains this information on a component basis, for all components of interest. (In addition, SSPI contains train level unplanned outage time.)</p>	<p>No work-around needed.</p>

<p><math>t_{sup}</math> (Support system outage time, used to estimate outage unavailability, U)</p>	<p>SSPI contains train outages due to support system failures or outages, for the systems in the SSPI scope.</p> <p>EPIX provides failures and unplanned outages directly for risk significant support systems outside the SSPI scope.</p>	<p>No work-arounds are needed.</p> <p>The work-around is to estimate planned outages (as discussed above under <math>t_{plan}</math>).</p>
<p>PRA PARAMETERS</p>	<p>AVAILABILITY UNDER VOLUNTARY APPROACH</p>	<p>POSSIBLE WORK-AROUNDS</p>
<p><math>N_{rf}</math> (Number of component failures during component operation, needed to estimate the component operating failure rate, <math>\lambda(r)</math>)</p>	<p>EPIX contains component level failures recorded against the discovery method, including those discovered while running, for all components of interest.</p>	<p>No work-arounds are needed.</p>

<p><math>t_r</math> (Operating time for rotating equipment and control valves, needed to estimate the component operating failure rate, <math>\lambda(r)</math>)</p>	<p>EPIX contains component level operating time, counted for components in the SSPI scope.</p> <p>For non-SSPI components, EPIX provides one-time estimates of operating time.</p>	<p>For SSPI-scope components, no work-arounds needed.</p> <p>For non-SSPI components, the staff will use information from LERs and testing information (Tech Spec, IST) and operating failure rate data from similar components. The estimates are expected to contain more uncertainty than the counted values discussed above.</p>
<p>PRA PARAMETERS</p>	<p>AVAILABILITY UNDER VOLUNTARY APPROACH</p>	<p>POSSIBLE WORK-AROUNDS</p>

<p>Concurrent train unavailable hours</p>	<p>SSPI currently collects unavailable hours on a monthly basis. For the systems in SSPI scope, this provides sufficient information to identify potential concurrent outages for further investigation.</p> <p>For Non-SSPI systems, EPIX does not directly provide component or train concurrent outage information.</p>	<p>For SSPI-scope trains, no work-arounds are needed.</p> <p>For non-SSPI components, concurrent unavailable hours cannot be estimated since planned maintenance outages are not recorded in EPIX. Some instances will meet LER reporting requirements.</p>
-------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------