UNITED STATES NUCLEAR REGULATORY COMMISSION

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(Information)

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For: The Commissioners

From: Victor Stello, Jr.
Executive Director for Operations

Subject: NUCLEAR PLANT RELIABILITY DATA SYSTEM (NPRDS)

Purpose: To provide the Commission with information on the status of the NPRDS and progress since the Institute of Nuclear Power Operations (INPO) assumed responsibility for the system.

Discussion: In SECY-81-494 written in August 1981, the staff proposed dropping component failure reporting requirements from the operational data rulemaking then in progress. This proposal resulted from the July 8, 1981 announcement that INPO had decided to assume responsibility for management and funding of the Nuclear Plant Reliability Data System (NPRDS). The staff believed that INPO's action provided a basis for confidence that the two principal deficiencies that had made NPRDS an inadequate source of reliability data would be corrected, those deficiencies being (1) the inability of an ANSI-sponsored committee management structure to provide necessary technical direction, and (2) a low level of utility participation. In its affirmation of SECY-81-494, the Commission directed the staff to proceed with the LER portion of the rulemaking, and to closely monitor the progress of INPO's management of the NPRDS. The staff was requested to provide the Commission with semi-annual status reports on the effectiveness of INPO management of NPRDS and the responsiveness of NPRDS to NRC needs.

Over five years have passed since INPO assumed full responsibility for the NPRDS in January 1982. In that time the staff has prepared 10 reports on the progress of the system. It seems appropriate to sum up the progress of the system over that time and to compare the current situation with the goals and expectations stated when the rulemaking was modified.

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Brief Description of the NPRDS

The scope of the NPRDS, i.e., what plant equipment is covered by the reporting requirements, has broadened since INPO assumed direction. In addition, the other major features of the NPRDS, established prior to the staff rulemaking and INPO's takeover, have continued to the present. For each component in the scope, utilities submit two kinds of reports to the system: (1) component engineering reports, and (2) component failure reports. Each component engineering report contains descriptive information about an installed component, such as manufacturer, model number, the system it is installed in, flow capacity, rating, etc. In addition, it contains estimated information on how the component is tested, both how often and for how long.

Component engineering reports are usually submitted in advance of commercial operation when failure reporting begins. This feature provides the capability to identify where similar components are installed throughout the industry.

A failure report is submitted when a covered component "fails," i.e., cannot fulfill its design function. The failure report identifies the component, in part so that the failure can be matched to the corresponding engineering report, and provides: the date and time of failure; the length of time it took to restore component function; a description of the failure and corrective action (both through text and selected codes).

The data base was originally designed to support calculation of most of the statistics used in simplified reliability models, such as those used in WASH-1400. Notable exceptions are the absence of data on preventive maintenance and of data on actual demands (as opposed to test demands). The absence of actual demand data is not a major problem per se since (1) in most cases test demands (test frequency is provided in the NPRDS) greatly exceed actual demands (so the impact on the ratio of failures to demands is negligible), and (2) the failure on demand probability usually can be estimated using the failure rate per component standby hour available from the NPRDS. The statistics were meant to be averages across many plants and many components for use in reliability analyses and risk assessment analyses to improve designs and optimize test and inspection frequencies. Statistical analyses of component wearout, the impact of planned (preventive) maintenance, and tracking individual components throughout their lives are examples of more sophisticated uses not included in the original design but now becoming important.

The staff provides regular input regarding the NRC's data needs to INPO through participation in the NPRDS User's Group. This body, consisting of rotating assignees from utilities and representatives from DOE, NRC, EPRI, NSSS vendors, and AEs, provides advice to INPO and supports task groups on selected issues. NRC participates as one of many users, and NRC proposals or suggestions are considered in the same manner as those proposed by other members.

INPO Technical Management

In 1981 the staff believed that INPO could provide the resources and full time centralized technical direction to the NPRDS that had been previously lacking.

Since 1982 INPO has made a significant resource and management commitment to NPRDS. The NPRDS Department now includes 15 professionals working full time on NPRDS, and has work placed with contractors, including three full time failure auditors. This commitment has resulted in major improvements to the NPRDS, most notably in reporting guidance and access to the data base. Reporting guidance has been improved through revision of the Reporting Procedures Manual, issuance of a detailed scoping manual (to define what components are covered), sponsoring reporting workshops, and providing full time guidance by telephone on questions about the system. During the same period of time, INPO moved the computer operation of the system from a contractor to in-house and established remote interactive data reporting and data retrieval to replace batched reporting on punched cards or tape and data retrieval through requests to a contractor.

INPO maintains an ongoing qualitative review of failure reporting performance that includes timeliness, reporting volume and report quality. Low volume or consistently late reporters are identified for followup remedial action in an attempt to clarify and resolve problems. However, INPO does not have quantitative measures of data base completeness or quality. INPO's major strategy to gain improvement is to encourage the use of the data, both in-house and by utilities. To this end, INPO embarked a number of years ago on a massive project to re-design the data base and write end-user programs (for example, to automatically calculate failure rates). This project, called the IBM conversion, is just now entering the trial use phase; NRC is one of the trial users.

The quality of the engineering data has received less attention. INPO devoted significant resources to working with utilities in a multi-year effort to change the scope from safety components as defined in proposed or existing ANSI standards to components in specific systems that were either the sources of transients, e.g., the feedwater system, or were used to mitigate accidents. However, the quality and consistency of the resulting engineering data base is only now receiving limited systematic review.

Industry Participation

In 1981 the principal staff concern was the low level of industry participation in NPRDS failure reporting, especially since the NPRDS was the only system specifically dedicated to the collection of component failure data. Thus, the staff evaluations have focused on characterizing overall changes in the completeness, timeliness and quality of failure reporting and the consistency of reporting across plants.

Figure 1 shows the significant growth in the volume of failure reporting activity (new reports plus revisions) from about 500 reports per quarter to about 5000 reports per quarter between 1982 and 1987. Figure 2 shows the post 1984 data corrected for growth in the reactor population. Overall failure reporting volume across the commercial plants (i.e., those eligible for NPRDS reporting) appears to have reached a plateau value of around 5000 reports per quarter or 50 to 60 reports per quarter per eligible plant for new failures plus revisions. Plants that were in commercial service for all of 1986 reported a net total of 13,500 failures occurring in that year. The plant-specific reporting rate is very uneven, and ranged from 21 to 423 failure reports per year, with a median of 145 and a mean of 159.

There has always been a significant time lag between the date a failure occurred and the date the failure report could be found in the data base. In 1982, when failure reports were submitted in batch, lag times over a year were not uncommon. Today, the median time to submit a failure report is approximately 90 days after discovery of the failure. The timeliness for individual plants varies widely, where the medians range from as low as 15 days to over 200 days. (INPO guidance is to submit a failure report 30 to 60 days after discovery of the failure.)

The staff has attempted to independently estimate how complete the reporting was across all eligible plants noting that the volume of failure reporting was at times influenced by large input from a relatively few plants. Specifically, the staff was interested in understanding or determining the percentage of failures reportable to the system that were actually being reported. As one measure, in each calendar quarter, a sample of 100 failures occurring at a range of plants and described in LERs (and thus known to the staff) were the basis of a search of the NPRDS to locate corresponding failure reports. The percent located was used as a measure of completeness. Although the sample is small we believe it is representative. INPO reviews of completeness are based on review of utility maintenance work requests and give slightly higher results. The NRC results through 1986 are shown in Figure 3. The figure shows that in both 1985 and 1986 about 65% of the failures in the sample were in the data base about 9 months after the date of failure. The track of the percent complete as calculated 3 quarters after the date of failure (including the 87-1 calculation for failures that occurred in 86-2) is shown in Figure 4. Thus, like the volume of failure reporting, this measure may have reached a plateau at about current levels, i.e., 65%.

Some reports will always be missing due to random errors in reporting and reasonable disagreement over whether a specific corrective maintenance event constitutes a reportable failure within the rules of the system. Over the years, the staff has repeatedly compared its interpretation of the NPRDS component failure reporting requirements with that of other users including INPO. In general, the interpretations agree within about 10%.

The staff review of failure report quality has focused on the narrative provided by the licensee to describe the failure and the corrective action. For the semi-annual evaluations, a sample of failure reports has been reviewed to determine if the text described the failure in sufficient detail that users could understand and apply the information (e.g., assess applicability to other plants). Figure 5 shows the recent trend in this measure. In the latest data examined, 50% of the samples were rated as "adequate" (i.e., a knowledgeable person could understand the characteristics of the failure) or better, and an additional 44% were rated "probably adequate," but few described the root causes.

For the period 1982 through 1987, the volume of NPRDS engineering records grew from about 140,000 to 450,000. This growth occurred as additional plants became commercial, previously non-participating plants added data, and older plants expanded their data to the larger scope. All commercial LWRs have submitted engineering data. The plant engineering record data quality and completeness vary widely, even for similar plants, and range from around 2700 engineering reports (at an older PWR) to 10,800 (at one newer BWR), with most plants in the 3-6 thousand range. The quality of the engineering data, and why essentially similar plants have a considerable difference in the number of components within the scope of NPRDS, has not been systematically assessed, beyond the automated (computer based) data entry checks instituted by INPO. The quality of these engineering records represents a fundamental problem in the NPRDS. Experience in using this data is discussed below.

NRC Staff Uses

To date, NRC staff use of NPRDS has been limited. One factor responsible for the limited usage has been the slow rate of improvement of the data base. Although INPO assumed management of the system in 1982, it wasn't until July 1986 in SECY-86-216 that the staff concluded that "current levels of participation warrant increased use of the system." Another factor has been access and training limitations imposed by INPO. Throughout the period since its takeover, INPO has expressed the concern that heavy NRC usage, including that by regional offices and contractors, would swamp the system and drive out utility users, especially prior to the IBM conversion. Thus, only a few individuals outside AEOD held access codes. Recently, a contract with INPO was signed that provides NRC access and training on a somewhat broader basis.

As stated previously, the original design of NPRDS supported calculation of basic reliability statistics, such as failure rate per hour and mean time to restore function, for use in reliability and risk models. However, major PRA programs such as the risk method integration and evaluation program (RMIEP) and the risk rebaselining for NUREG-1150 made only qualitative use of NPRDS (e.g., review for failure modes), because of concerns about system quantitative accuracy. This use was in keeping with the state of the NPRDS when these efforts started several years ago.

AEOD has statistically explored variation in failure rate as part of a larger engineering study of selected key components in the balance of plant (BOP). In that effort, it became clear that the NPRDS engineering records were not reliable, and thus most of the plants involved had to be individually contacted to verify and correct the engineering data records. The conclusions from these studies, with their bases, have been provided to INPO for their appropriate action.

For the most part, staff use of the failure data in NPRDS has been qualitative rather than statistical or quantitative. AEOD case studies include a review of NPRDS as well as LERs to identify relevant events and to attempt to identify root causes. Research used NPRDS in the Nuclear Plant Aging Research (NPAR) Program to identify components and systems that are most subject to aging in connection with plant life extension. The staff has used the engineering data file in much the same way as utilities to locate similar equipment across the industry. In this regard, the NPRDS is often adequate to distinguish between an isolated problem (i.e., one involving few uses of a particular component) and a widespread problem.

The industry proposed the use of NPRDS to address safety issues related to vendor technical interfaces. Since December 1986, the staff has accepted licensees' commitments to the Vendor Equipment Technical Information Program (VETIP) developed by the Nuclear Utility Task Action Committee (NUTAC) as a response to item 2.2.2 in Generic Letter 83-28, "Vendor Interface Programs." This program enhances information exchange and evaluations on components among utilities via participation in NPRDS. The VETIP is based on complete and timely reporting to the NPRDS, and in basic agreement with past staff assessments of the system, includes recommendations to utilities and INPO for enhancements such as accelerated failure reporting, improved guidance for more consistent reporting, and improved failure narratives. Each utility receiving credit for VETIP must commit to these enhancements.

Additional staff uses of the NPRDS are developing as the plant population ages. In connection with the NRC approval of GE BWR reactor protection system (RPS) technical specification surveillance frequency changes, the feasibility of monitoring the RPS reliability through NPRDS is being pursued. This need for further component reliability monitoring is expected to increase as licensees propose the relaxation of surveillance requirements over the lives of the plants.

Evaluation

The volume of failure reports reaching the NPRDS today makes the NPRDS a serviceable source for the component level failure information. It also captures data on certain BOP components, a portion of the plant which has been repeatedly cited as needing improvement to reduce challenges to safety systems. User confidence is the fundamental problem currently surrounding the NPRDS. This stems from the lack of accurate and complete engineering records for the components within the reportable scope, even the most important of these components.

NPRDS provides the only extensive collection of component engineering data. The descriptive fields such as rating, material, and flow capacity have been found to often be inaccurate in the staff use to date. However, while accuracy in these fields is desirable, it is less important than providing accurate model numbers, updating the information when components are replaced and assuring completeness in capturing key components. The utilities and INPO need to implement the recently developed enhancements for model number consistency and place greater emphasis on keeping the basic engineering data current. However, beyond this, complete and accurate engineering data is needed for at least a subset of the NPRDS components (key components).

The NPRDS engineering data has not yet received the same level of scrutiny from INPO as failure reporting. The volume of this information, over 450,000 records, is one reason. To meet current staff and industry use (e.g., to identify similar equipment across the industry) consistent model number coding, keeping the data current, and consistency/completeness in capturing data for key components (all data elements) are most important. INPO has laid the groundwork in these areas and needs to proceed expeditiously. The staff has recommended that INPO upgrade the quality of the engineering data for a selected set of key components (about 450 per unit) on a priority basis across all plants to cause a step improvement in the usefulness of the entire data base.

The current NPRDS was designed primarily to provide basic component failure rate statistics for independent failures, i.e., failures per component operating hour or standby hour. It was used only in a peripheral way in past PRAs because of the concern that limited participation by utilities might produce biased results. Thus, it was used primarily as a source of information on failures modes rather than failure rates. As participation has improved, NPRDS currently can be utilized as a data base to support PRA applications. As a result, the Office of Nuclear Regulatory Research intends to use NPRDS data as the initial source to derive independent failure rates for future PRA activities provided participation in the program is maintained.

The size and cost of a system like NPRDS could not be justified if the sole purpose was to calculate failure rates for PRA. Such a use is too far removed from providing an immediate benefit (and hence motivation) to the plants providing the data. Hence, near term uses such as identifying component generic problems, providing potential sources of equipment spare parts, and the exchange of component failure experience are dominant. To chart a course for future development, a subcommittee of the NPRDS Users Group, with NRC participating, is revisiting the NPRDS objectives in view of these near term uses, support of PRA, and developing needs for additional component-level data. The subcommittee has been working on more explicitly defining the NPRDS functions, subfunctions and uses. The six broad functional uses of the NPRDS identified by this group were: to monitor equipment performance, to provide a data base for analytical studies, to locate equipment, to support plant life assurance and extension, to monitor plant equipment availabilities (balance of plant), and to assess test and inspection frequencies. These uses provide the general goals and direction for NPRDS development. New or emerging staff data uses will be communicated to INPO and pursued in proportion to their importance to NRC's mission.

Summary and Future Direction

During the past six year period, INPO has made major improvements to the NPRDS through soliciting industry support, providing better technical guidance, enhancing quality assurance, and making data more accessible. Today's NPRDS has a failure reporting volume roughly ten times that in 1982 and it is estimated that 65% of the reportable failures occurring throughout the industry are being routinely reported. The median time to submit failure reports has been reduced significantly to about 90 days.

Further improvements in quality and timeliness are anticipated in response to two industry actions already underway. In the first action, a large number of licensees have made a commitment to complete and timely NPRDS reporting in response to Generic Letter 83-28. Secondly, further improvement in failure data reporting is anticipated with expanded utility use following the IBM conversion with a more user friendly program.

While the gains and improvements over these six years have been impressive and reflect credit on INPO and the nuclear industry, the problem of accuracy of the engineering data base remains as the largest issue.

Recognition that the NPRDS while a voluntary industry program was an alternative to a proposed regulatory program has caused the staff to maintain a close oversight. Since 1982, the staff has monitored the completeness, quality and timeliness of NPRDS data. The principal effort in this regard has consisted of assessing the completeness of reporting against component failures identified in licensee event reports. This review also served to calibrate the adequacy of the cause of failure description and the timeliness of reporting. While this monitoring program has been effective in identifying and characterizing the degree of improvement in the NPRDS, this sampling activity is apparently not effective in causing further improvements in quality and timeliness and it will not contribute to improvements in accuracy of engineering data. Consequently, a revised staff monitoring program has been defined to shift NRC emphasis away from the past LER sampling activities in order to make more effective use of available resources.

In the future the staff will monitor the NPRDS program through: direct use; specific plant evaluations as part of maintenance assessment; and through site visits at selected plants. The incorporation of specific plant evaluations of NPRDS into the Maintenance Assessment Program has been coordinated with NRR. Further, the staff will communicate with INPO on the need and use of NPRDS data. Thus, the future course of action with respect to NPRDS will consist of the following:

1. Since effective maintenance programs include a component failure monitoring, reporting and assessment function, the NPRDS implementation will be included in the evaluation of industry maintenance initiatives. In addition, visits will be made by AEOD staff to selected operating plants to discuss and review NPRDS implementation. For example, plant visits were conducted in November to IP-2 and 3, and to Calvert Cliffs in early December.

2. Staff and contractor use of NPRDS are expected to increase substantially in view of: the large volume of NPRDS data accumulated and being submitted; the uniqueness of the information; the improvement associated with the IBM conversion; and the NRC-INPO contract for staff access. Staff use of NPRDS will be evaluated in terms of accessibility and useability of the information, the results of validation checks conducted, and whether staff needs were satisfied.

3. INPO will be formally notified with respect to the priority NRC places on assuring that the engineering data for 400-450 key components are validated for all plants.

In view of the current status of NPRDS and the time period for these actions (over the next two years), an annual NPRDS report is considered more appropriate. Accordingly, unless a new trend develops, I plan to perform future staff evaluations with this periodicity.

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for Operations

Enclosures: As stated

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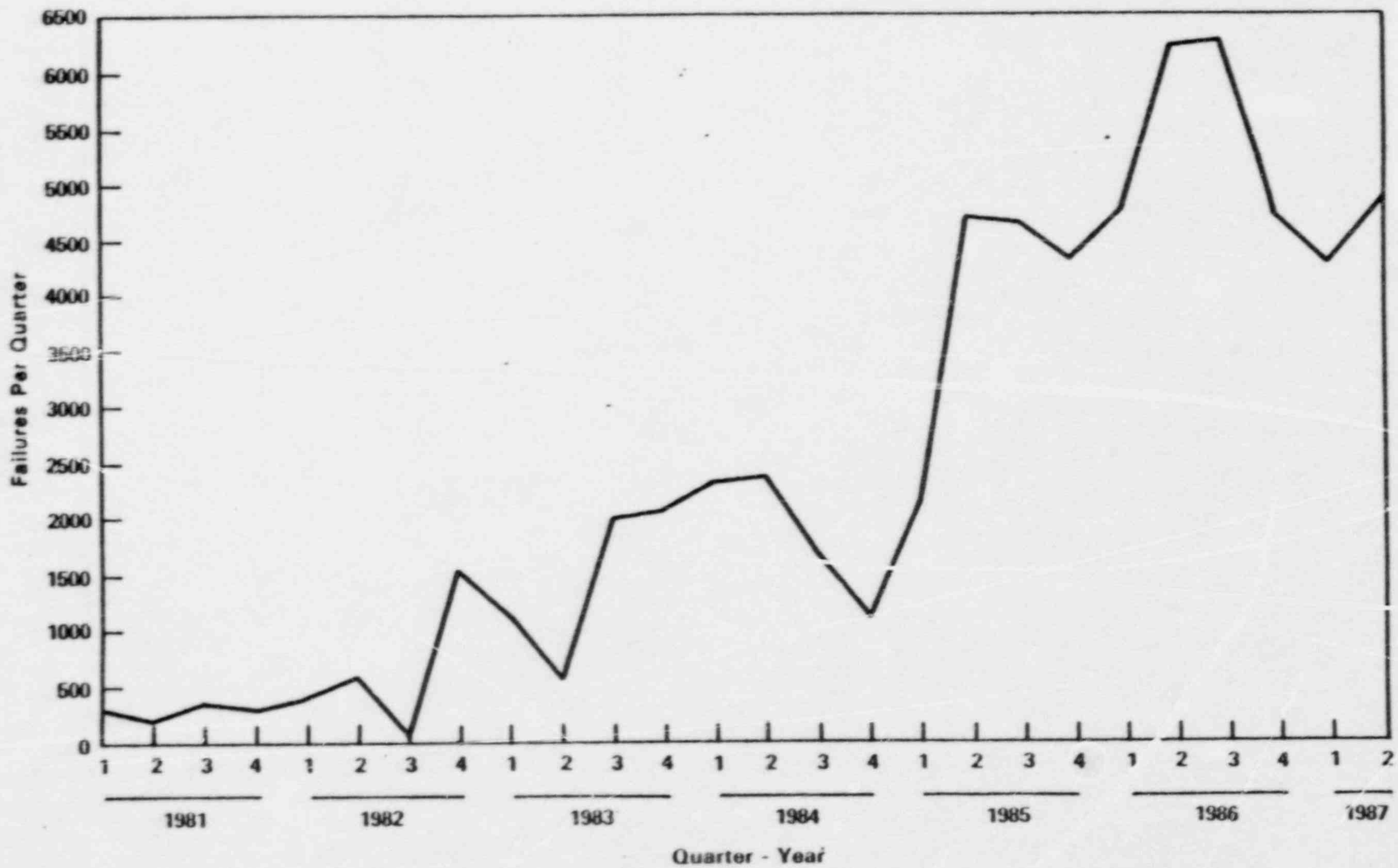

Figure 1 Component Failure Transactions by Calendar Quarter.

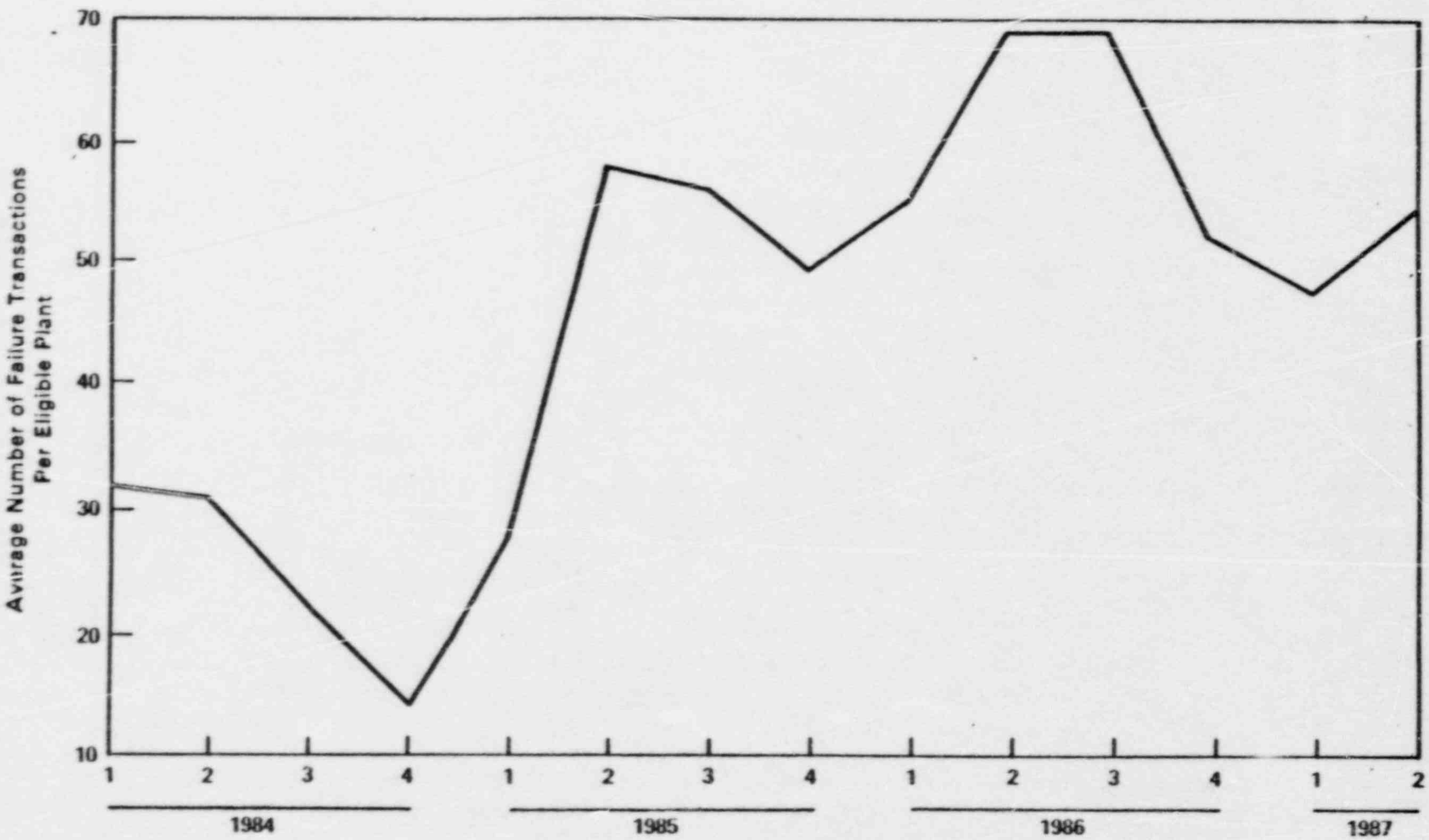

Figure 2 Measure of NPRDS Participation.

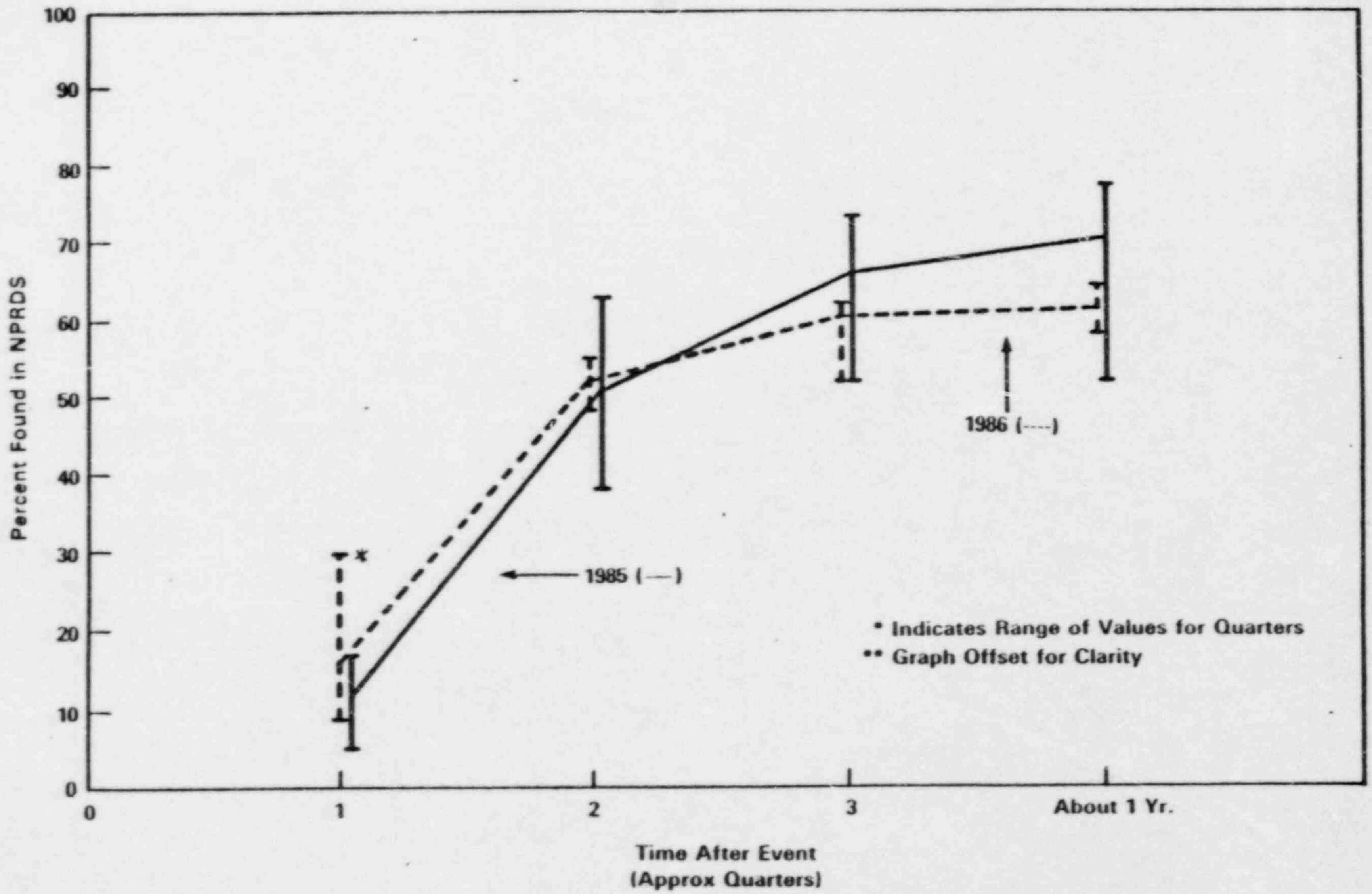

Figure 3 NPRDS Completeness vs. Time
(Based on 1985-86 LER Sample Failures).

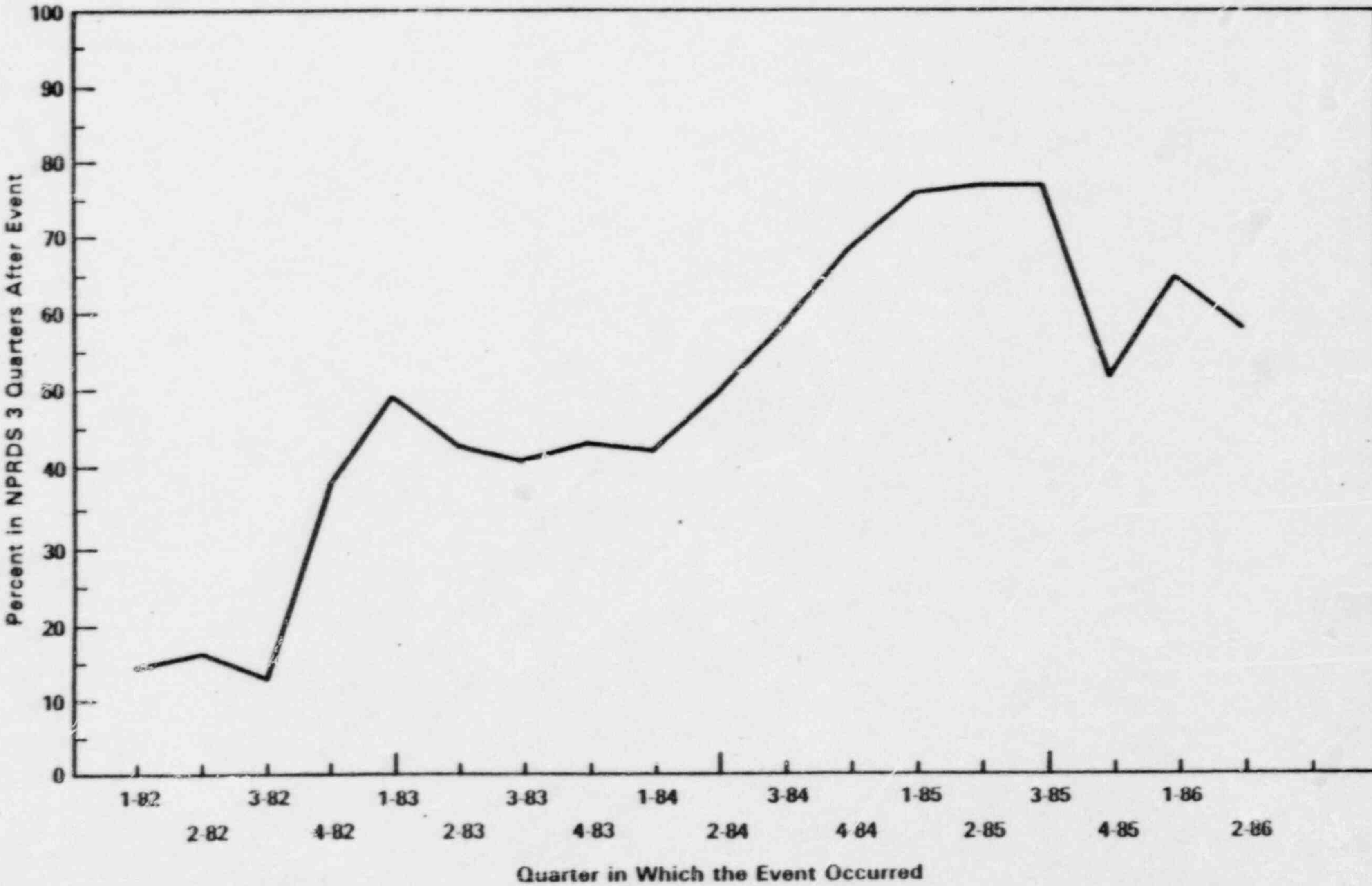

Figure 4 NPRDS Reporting Completeness
(Based on LERs Only).

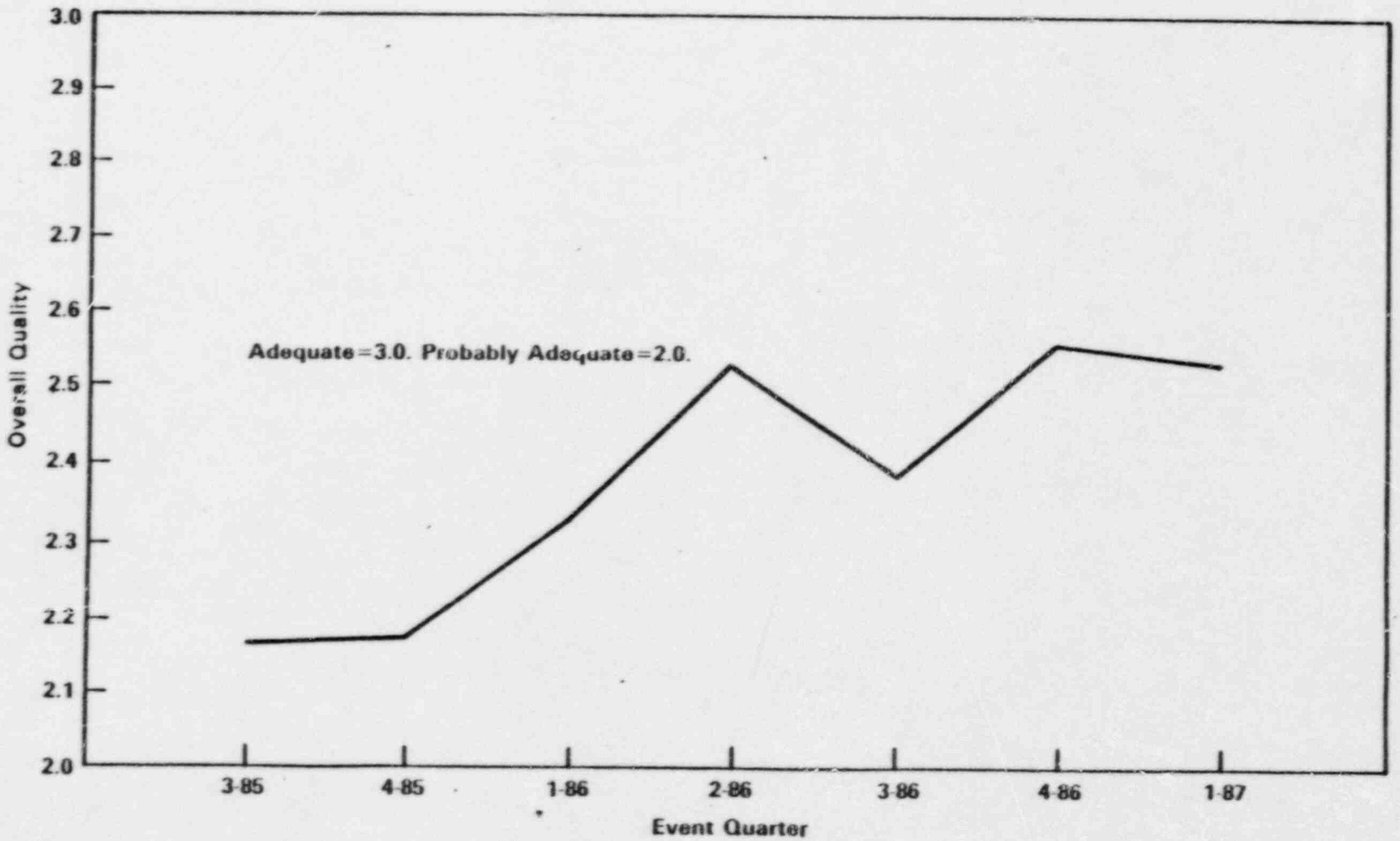

Figure 5 NPRDS Narrative Quality.