Docket No. 50-423
B13436

Attachment 1

Integrated Safety Assessment Program

Executive Summary

May 1991

MILLSTONE UNIT NO. 3
INTEGRATED SAFETY ASSESSMENT PROGRAM
EXECUTIVE SUMMARY

In May 1985, the Nuclear Regulatory Commission approved a pilot Integrated Safety Assessment Program (ISAP) for Northeast Nuclear Energy Company's (NNECO) Millstone Unit No. 1 and Connecticut Yankee Atomic Power Company's (CYAPCO) Haddam Neck Plant. ISAP represented a new approach to nuclear regulatory and licensee decision making, and responded to long-standing NRC support for a systematic review of the safety of operating nuclear power plants. Specifically, the ISAP evaluates proposed resolutions to licensing issues, and licensee-initiated plant improvement projects. NNECO now intends to expand this project evaluation tool to Millstone Unit No. 3.

The objective of the Millstone Unit No. 3 ISAP is an analytical evaluation, which supports the prioritization process. For this application of the ISAP, NNECO has expanded the use of a detailed analytical ranking methodology (ARM). Each ISAP topic that has a well-defined scope will be evaluated, utilizing this methodology, for potential impacts on each of four attributes: public safety, personnel safety, plant economic performance, and personnel productivity. NNECO has developed models for assessing and scoring the various impacts in each of these categories. In addition, the ISAP methodology applies weighting factors to integrate the four individual attribute scores for each topic into one composite topic score. This score, in turn, serves as the basis for ranking, or prioritization, of all topics within the ISAP scope of review. Operating experience review data is utilized during the course of these evaluations, as available.

This initial report summarizes the ISAP prioritization process. Detailed, project specific topic information is also included. The evaluations, scores, and rankings from the ISAP prioritization process are used along with other pertinent parameters to determine the final resolution, and schedule, for each topic. The ISAP includes a threshold concept for eliminating proposed backfits which are not justified based on the evaluation of benefits and costs.

In addition, the project scores and rankings are an important consideration in the development of an Integrated Implementation Schedule (IIS). This approach to the list of pending plant modifications inherently assures that the projects with the greatest potential benefits - public safety and other benefits - are assigned the highest priority. Issues with little or no benefit can be deferred or dropped, thereby conserving limited resources for allocation to the most important projects.

Finally, this ISAP submittal represents another milestone toward a multi-unit, Integrated Implementation Schedule for all of Northeast Utilities' operating units. This first Millstone Unit No. 3 IIS will be updated periodically. These IIS submittals will be reviewed by NRC Staff, afterwhich resulting issues will be addressed, discussed, and resolved.

Docket No. 50-423
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Attachment 2

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program

Program Overview

May 1991

INTEGRATED SAFETY ASSESSMENT PROGRAM

Introduction

ISAP has evolved from several precursor programs which were oriented towards reviewing the current status of the plant. The current licensee-initiated ISAP for Millstone Unit No. 3 is an extension of these earlier programs at Millstone Unit No. 1 and the Haddam Neck Plant. The program was developed and has expanded to foster effective corporate assessment and decision making for NRC initiated and licensee initiated issues and to facilitate an Integrated Implementation Schedule (IIS) with respect to implementation of new and existing plant improvement projects. NNECO continues to move in the direction of utilizing the evolving methodology as part of ISAP, in the spirit of Generic Letters 88-02 (ISAP II) and 88-20 (IPE) and Regulatory Impacts Survey results Integrated Regulatory Requirements Implementation Schedule (IRRIS), to facilitate objective and integrated decision making with respect to resource management.

History of ISAP

ISAP is a documented and exercised approach to overall plant assessment, responding to long-standing support within the NRC for a systematic review of the safety of operating nuclear power plants. The program is a logical successor to several earlier NRC programs.

First, in 1977, the NRC initiated the Systematic Evaluation Program (SEP) to review a specific set of safety issues for eleven of the oldest domestic operating reactors, including Millstone Unit No. 1 and the Haddam Neck Plant. The SEP was intended to evaluate these licensed plants against then current NRC criteria and to develop a framework for backfitting decision making. The SEP provided significant information relative to the safety of operating plants and provided important experience in the development of evaluation techniques for operating plants.

Subsequently, following the Three Mile Island Unit No. 2 (TMI-2) accident, the NRC developed the TMI Action Plan. The TMI Action Plan identified a large number of corrective actions to be implemented by operating plants. In addition, the NRC initiated the Interim Reliability Evaluation Program (IREP). Under IREP, plant-specific probabilistic safety assessment (PSA) studies were performed by the Staff for several operating reactors in order to supplement the reliability experience from the Reactor Safety Study (WASH-1400). The experience from IREP indicated that there are plant-specific strengths and weaknesses, from a reliability point of view, that warrant further consideration beyond the deterministically based issues of the TMI Action Plan.

One of the most significant conclusions drawn from SEP, the TMI Action Plan, and IREP was that issues related to the safety of operating nuclear power plants can be more effectively and efficiently evaluated in an integrated plant-specific review. Such an integrated plant-specific review would

evaluate all proposed projects for safety significance in light of all other on-going projects, and would attempt to assess all potential impacts of the projects (i.e., those impacts in addition to public safety). Such a review would also provide an ideal framework for backfitting decision making and the scheduling of justified backfits. Finally, experience from IREP served to define methods for conducting a plant-specific probabilistic safety analysis so that consistent, comparable results can be obtained. Probabilistic safety analysis would clearly enhance an integrated plant safety assessment.

Millstone Unit No. 1 and the Haddam Neck Plant were directly involved in SEP, and Millstone Unit No. 1 participated in IREP with the NRC Staff (Reference 1). Given the positive experience of the SEP effort, in a number of letters in 1983 (References 2 through 6), the NRC discussed our proposal that the NRC Staff expand the SEP integrated assessment for Millstone Unit No. 1 and the Haddam Neck Plant.

The NRC Staff concluded that an overall integrated assessment, which included all of the pending licensing requirements, would indeed lead to an effective and efficient backfit implementation program. Policy and programmatic issues related to the implementation of ISAP which had to be resolved before undertaking such an evaluation program were resolved when the Commission unanimously approved SECY-84-133 on March 23, 1984 (Reference 7). On November 9, 1984, the Commission issued a Policy Statement (49 Fed. Reg. 45112) on the implementation of ISAP, endorsing the concept. The NRC provided the go-ahead for a pilot ISAP program involving plants selected by the Staff from industry volunteers. Subsequently, the Commission approved SECY-85-160 (Reference 8), an implementation plan for the Millstone Unit No. 1 and Haddam Neck Plant pilot ISAP programs.

By letters dated July 31, 1986 and December 12, 1986, (References 9 and 10) NNECO and CYAPCO submitted comprehensive reports on the Millstone Unit No. 1 and Haddam Neck Plant ISAPs. The reports reflected several years of activities with the NRC on the development and implementation of pilot programs to assess and prioritize pending plant modifications and licensing issues. The NRC Staff issued for comment draft NUREGs 1184 and 1185 for Millstone Unit No. 1 and the Haddam Neck Plant, respectively, by letters dated April 2, 1987 and August 18, 1987 (References 11 and 12). Therein the NRC recounted its review of NNECO and CYAPCO's topic evaluations and prioritization, the respective Probabilistic Safety Study (PSS), and the Operating Experience Reviews.

More recently, the NRC Staff issued Generic Letter 88-02 Integrated Safety Assessment Program II to describe ISAP II, a derivative of ISAP, to ascertain utility interest in participating in the program. NNECO responded in the affirmative and further announced intention to expand ISAP application to Millstone 3.

NNECO has expanded this process to Millstone Unit No. 3. ISAP is an on-going, evolving process. The ISAP mechanisms for this on-going process are described in this submittal.

ISAP Process

The Millstone Unit No. 3 ISAP involves three phases: Analytical Ranking Methodology (ARM), Prioritization Screening (PS), and Integrated Implementation Schedule (IIS) as described in the ISAP Flow Chart (Figure 2.1) located in the back of this attachment. The ARM is the process by which individual projects, both NRC-initiated and licensee initiated, are evaluated relative to each other to establish a relative ranking. The ARM includes individual models for scoring these topics with respect to four attributes which have been judged to represent NU's goals and objectives. These attributes are public safety, personnel safety, economic performance, and personnel productivity and will be addressed in Attachment 3. Scores from the four attributes are summed and then divided by remaining project cost, resulting in a benefit to cost ratio called the rank value.

The output of the ARM is a relative ranking of the outstanding projects for which evaluations have been performed. The ARM does not attempt to define any implementation schedules. The ARM is designed to provide an objective basis for ranking candidate plant improvement projects. However, the overall ISAP process cannot be completely mechanistic.

The second step in the overall evaluation process--and therefore in the development of the IIS--is the Prioritization Screening (PS). The PS is a screening process for the ARM initial project rankings to assure that the prioritization is reasonable, accurate, current, and appropriately reflects other external factors. A second purpose of the PS is to assess, prior to the development of implementation schedules, whether a project, on a "benefit/cost" basis, is justified to be implemented. Those backfits that do not pass this "benefit/cost" evaluation threshold would be dropped. The backfits that are justified, are ranked and factored into the integrated implementation schedule. This highlights one of the most significant differences between NNECO's program and the living schedule approach that has been used by other utilities. One form of the integrated living schedule concept used by others has as one of its starting assumptions the understanding that all pending backfits and plant improvements are justified and will ultimately be implemented. Implementation dates are then based on an assessment of the particular project's safety significance. This approach to the living schedule concept does not attempt to define an acceptance criterion below which a plant modification will not be implemented. Although some schedules may be far in the future, it is implied in the living schedule concept for other utilities that everything has to get done sometime. The most significant benefit of the integrated assessment used in ISAP is that it establishes a benchmark against which all future requirements are evaluated. Thus, rather than assuming every future requirement is desirable with respect to plant safety, an integrated assessment methodology is used as a basis for assessing the overall significance of a requirement and making reasoned, prioritized plant improvement decisions. The PS considers other factors (e.g., project economics, installation man-rem exposure, and external impacts), and as a

result, the initial ARM rankings can be revised. The PS phase will be addressed in detail in Attachment 3.

Following completion of the PS, the third phase of ISAP is the IIS. This application of the integrated schedule at Millstone Unit No. 3 is conceptually no different than has been applied at Millstone Unit No. 1 and the Haddam Neck Plant. The IIS is a long-term (approximately 3-cycle) schedule for implementation of ARM evaluated plant improvements that makes the most efficient use of NRC and utility resources without compromising safety. The integrated schedule recognizes the importance of public safety impacts, as the public safety model plays a key role in the ISAP methodology. Concurrently, other relevant resource limitations such as budget considerations, manpower availability, equipment delivery schedules, and duration of outages are considered. Additionally, the integrated schedule accommodates changes in priorities and project scope in a cost-effective manner. The IIS, depicted in this first submittal, represents implementation dates for only those projects for which ARM evaluations have been completed. As more topics undergo cyclic ARM evaluations, their respective implementation status will be included in the IIS. As this cyclic process continues, the comprehensiveness of the IIS will correspondingly increase.

Number of Modifications

Although the number of proposed modifications pending for Millstone Unit No. 3 is not as large as the number for Millstone Unit No. 1 and the Haddam Neck Plant had been, new NRC requirements and NNECO initiatives for plant improvements are inevitable and the need for an IIS exists. Recognizing that the resources available for backfitting on nuclear units are finite, ISAP evaluates each outstanding backfit to determine whether it is justified for implementation and its relative ranking. The IIS then assures that the issues with the greatest potential impact on public safety will be assigned their proper priority for resolution. Issues with little or no impact will be deferred or dropped, thereby conserving resources for allocation to the most important matters. The ARM, PS, and IIS thus accomplish the objective of facilitating implementation of plant modifications with a logical, reasonable, and consistent methodology. Importantly, the process recognizes the potential for emergent issues requiring prompt resolution; these projects are given top priority until resolution is complete.

Of perhaps equal importance in this context is the point raised in the Executive Summary regarding our progress towards a multi-unit IIS for all of NU's operating units. Given our mutual objective of allocating our resources such that overall public safety is improved at the fastest possible rate, equally allocating resources at our four units may not be the optimum allocation. We intend to continue to refine our process with continuing maturation of the ISAP process. Factors such as relative core melt frequency estimates would be important parameters in this decision making process.

NRC Oversight

The IIS is developed and issued based upon the ISAP prioritization and scheduling process. The IIS is a schedule for evaluated projects and selected engineering studies that NNECO plans to undertake or that are in progress. The IIS may also incorporate activities requiring significant resource expenditures that have not been included within the scope of ISAP.

Typically high ranking topics would be scheduled within the IIS to be accomplished within one or two refuel cycles. Moderate ranking topics would normally be scheduled to be accomplished within two to three refuel cycles. Lower ranking topics would be scheduled accordingly or dropped. Engineering studies, previously discussed, are scheduled according to urgency and available analytical resources.

An important aspect of NNECO's IIS planning effort is the recognition that the schedule may need to be modified at times to reflect changes in or newly-identified regulatory requirements, incorporate newly identified resolutions to previously deferred ISAP topics, to accommodate new activities identified by NNECO to improve plant safety, efficiency, and reliability, and take into account delays resulting from events beyond NNECO's control. The procedures for determining the schedule outlined above will be followed for changes to the schedule. In addition, however, it is important that changes to the schedule be documented and that NRC Staff play a role in the oversight of the scheduling process.

Inherent in the concept of ISAP and the IIS is the responsibility on the part of NNECO that the integrity of ISAP and the IIS is maintained, the progress of all work undertaken is monitored, activities to maintain the schedule are managed, and prompt actions are taken when a schedule change is needed. However, given the evolutionary development of the ISAP, in particular the ARM, NNECO reserves the right to modify the model, as appropriate, without NRC Staff approval.

In recognition of one aspect of this responsibility, NNECO will update the IIS approximately semiannually and submit the revised schedule to the NRC. In addition, NNECO is responsible for:

- o Performing such ISAP priority determinations as are necessary to support the revised IIS:
- o Scheduling new or changed activities to avoid rescheduling other activities well underway, if it can be reasonably achieved;
- o Summarizing progress in implementing plant modifications or engineering evaluations addressing NRC requirements or orders which have specific implementation dates; and
- o Identifying changes since the last report.

Activities in the IIS may need to be rescheduled by NNECO, consistent with applicable regulations and orders, without NRC Staff approval. NNECO may also add new activities to the IIS without NRC Staff approval. However, ISAP is an interactive program between NNECO and the NRC. In addition to the scheduling updates as described above, NNECO keeps the NRC Project Manager informed as to the need for significant changes in the schedule for activities addressing NRC-initiated regulatory issues; changes to the scope of existing ISAP topics (e.g., changes to a project intended to resolve a topic); or the addition of new topics within the program.

The NRC provides oversight to the IIS scheduling process based on a review of the IIS and periodic updates. NNECO and CYAPCO have formally requested NRC Staff feedback within 60 days from the Millstone Unit No. 1 and Haddam Neck submittals. Although requested for those two units, it is not applicable to Millstone Unit No. 3 for this initial submittal, but would be applicable with the next submittal. The NRC Staff also monitors NNECO's adherence to the IIS.

ISAP and the IIS do not in any way limit the NRC's licensing or enforcement authority with respect to binding legal obligations. Accordingly, where an implementation date for an activity is fixed by binding NRC regulation or order, NNECO is obligated to meet the date or seek an appropriate exemption to the regulation or modification to the order to support a later date in the IIS, or seek to eliminate the requirement in whole or in part. Also, to the extent an activity in the IIS is based on an NRC-initiated regulatory issue, NNECO is committed to continue to fulfill commitments as necessary to maintain substantive compliance with regulations. ISAP evaluation results, however, may assist in forming the appropriate bases for schedular or permanent exemptions to regulations or other NRC-mandated regulatory requirements.

In the event that topic implementation scheduling or proposed deletions within the periodic submittal report are incongruent with NRC Staff positions, any differences will be resolved through routine communication channels between NRC Staff and NNECO management personnel. Details associated with ISAP process operation, including NRC Staff and NNECO roles and responsibilities, were discussed in significant depth in the "ISAP Program Plan" letters which have been submitted for the Haddam Neck Plant and Millstone Unit No. 1, as proposed additions to their respective operating licenses. Once these pending license conditions have been resolved at those units, similar additions will be considered for Millstone Unit No. 3.

ISAP Process Flowchart

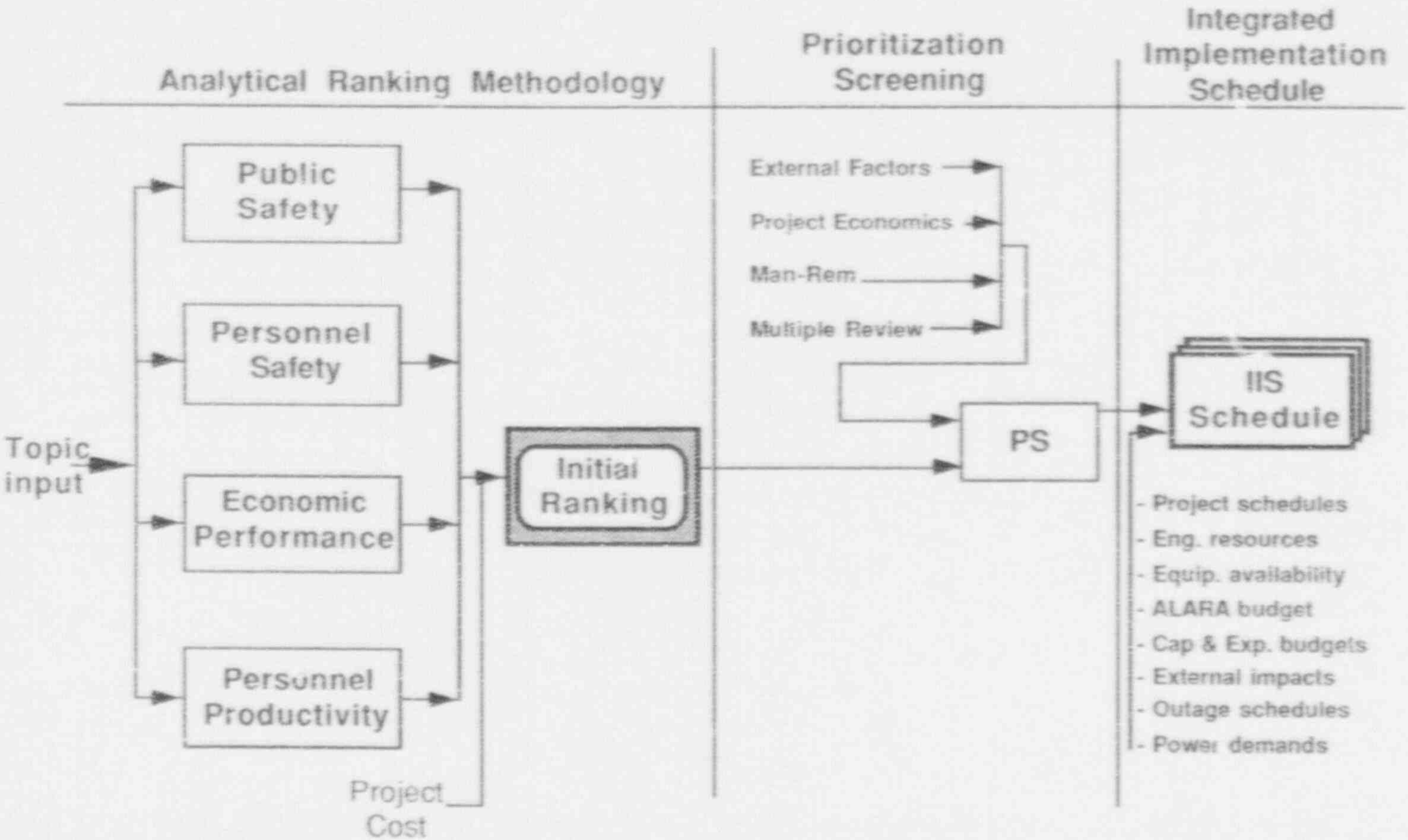

Figure 2.1

1. W. G. Counsil letter to D. M. Crutchfield, "Comments on Systematic Evaluation Program," A02644, dated July 30, 1982.

2. W. G. Counsil letter to W. J. Dircks, "Integrated Assessment of Regulatory Requirements," B10804, dated June 13, 1983.

3. H. R. Denton letter to W. G. Counsil, "Integrated Assessment of Regulatory Requirements," dated July 5, 1983.

4. W. G. Counsil letter to D. G. Eisenhut, "Integrated Safety Assessment Program," B10869, dated September 14, 1983.

5. D. G. Eisenhut letter to W. G. Counsil, "Expanded Integrated Assessments for Haddam Neck and Millstone Unit No. 1," dated October 5, 1983.

6. W. G. Counsil letter to D. G. Eisenhut, "Integrated Assessment of Regulatory Requirements," B10986, dated December 28, 1983.

7. W. J. Dircks letter to NRC Commissioners, "Integrated Safety Assessment Program," SECY-84-133, dated March 23, 1984.

8. W. J. Dircks letter to NRC Commissioners, "Integrated Safety Assessment Program--Implementation Plan," SECY-85-160, dated May 6, 1985.

9. J. F. Opeka letter to C. I. Grimes, "Integrated Safety Assessment Program--Final Report for Millstone Unit No. 1," dated July 31, 1986.

10. E. J. Mroczka letter to C. I. Grimes, "Integrated Safety Assessment Program--Final Report for the Haddam Neck Plant," dated December 12, 1986.

11. C. O. Thomas letter to E. J. Mroczka, "Millstone Nuclear Power Station, Unit No. 1--Draft Integrated Safety Assessment Report (NUREG-1184)," dated April 2, 1987.

12. C. O. Thomas letter to E. J. Mroczka, "Haddam Neck Plant--Draft Integrated Safety Assessment Report (NUREG-1185)," dated August 18, 1987.

Attachment 3

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program

Prioritization Process

May 1991

ISAP PRIORITIZATION PROCESS

Introduction

The assessment phase of ISAP, also referred to as the Analytical Ranking Methodology (ARM), generally focuses data collection and evaluation efforts to determine relative priorities for implementation of the proposed modifications or projects, although in process engineering "studies" may also be tracked. The prioritization process considers safety first, but not as the only consideration in evaluating projects. One major goal of the program is to achieve the largest safety benefit for the resources expended. In addition, inherent in NNECO's approach is the belief that any prioritization methodology must recognize the importance of utility-initiated improvements as well as NRC-required modifications. This was recently acknowledged by NRC Staff during presentation of the recent Regulatory Impact Survey results.

The first objective of the ARM is the relative ranking of proposed plant projects. The expected post-implementation impacts of each project considered under ISAP, relative to the previous plant condition, are treated as "benefits." These "benefits" can be positive or negative. The implementation impacts, including costs (dollars) and other considerations such as radiation exposure and schedular impacts, are treated as "costs." An evaluation of the "benefits" vs. "costs" is utilized as the principal determinant of each project's priority.

A secondary, but also important objective of the prioritization process is to take advantage of the multi-disciplined and organizationally diverse perspectives of the individuals involved in the process. These diverse perspectives contribute to the independent assessment of each ISAP issue in such a manner as to assure consistency, completeness and accuracy in the evaluation of each project.

Attribute Definition and Description

In order to determine the "value" of a proposed plant modification, NU has developed a set of attributes against which projects are evaluated (refer to Figure 2.1). These attributes were chosen in order to provide a broad perspective on the merits of potential plant improvement projects. The four attribute impact models that are utilized in the ranking methodology for the Millstone Unit No. 3 ISAP topics are:

- Public Safety
- Personnel Safety
- Economic Performance
- Personnel Productivity

Each of the attributes encompasses multiple characteristics or components. The personnel safety attribute, for example, includes both industrial safety

and radiation safety components; the economic performance attribute includes separate components for availability, reliability and maintainability impacts.

The four selected attributes for the ISAP prioritization process are described as follows:

1. <u>Public Safety</u> - This attribute captures the NU commitment to safe operation of its nuclear facilities by limiting the incremental risk to the public to an acceptably low level. The public safety attribute includes the characteristics of:

   - radioactive material release from the plant;
   - hazardous material (non-radioactive) releases from plant; and
   - hazards from transportation accidents offsite.

   The impacts of this attribute are determined utilizing "living" PRA results where applicable in conjunction with plant data and subjective engineering judgement.

2. <u>Personnel Safety</u> - This attribute captures the NU commitment to ensuring the safety of on-site personnel. The personnel safety attribute includes the characteristics of:

   - occupational radiation exposure; and
   - industrial safety.

   The impacts of this attribute are determined using a combination of quantitative and qualitative factors, including dollar value per Man-Rem, plant data, cost per lost workday, and potential company liabilities.

3. <u>Economic Performance</u> - This attribute captures the NU objective of furnishing reliable and economical power to their customers. The economic performance attribute calculates the potential change in plant output by evaluating the following characteristics:

   - plant availability;
   - plant reliability;
   - plant maintainability; and
   - plant efficiency;

   The impacts of this attribute are determined utilizing plant-specific reliability/availability/maintainability (RAM) models where applicable, combined with plant and industry performance data and both objective and subjective judgment to assess future impacts on plant output.

4. <u>Personnel Productivity</u> - This attribute captures the NU commitment to maintain an organizational culture conducive to high quality work with good productivity. The personnel productivity attribute includes the characteristics of:

- o effects on people;
- o effects on equipment; and
- o effects on work environment.

The impacts of this attribute are determined by subjective judgement supplemented by qualitative data where available, and include effects of changes in equipment or procedures on personnel efficiency, effects of training on productivity, and effects of physical stress and work environment on productivity.

The specific scoring approach and weighting factor methodologies for each attribute are discussed in the following sections.

Analytical Ranking Methodology

For the ISAP prioritization process, NU has developed the Analytical Ranking Methodology (ARM). The ARM includes models for evaluating the impacts of a proposed project for each separate attribute, and a methodology for combining those impacts to achieve an overall ranking. Development and application of the ARM is the most significant activity related to the ISAP prioritization process. The NU ISAP program defines multiple ranking criteria for use in assessing and ranking a spectrum of projects, modification and backfitting issues.

The ranking model has received an intense amount of scrutiny within NU. The ARM is sound, logical, objective, and recognizes that safety considerations are of primary importance. In order to ensure the methodology would be useful, it was first necessary to define its limitations and the pre-established factors that would be considered in its development. The discussion below defines those conditions and constraints.

Public Safety

The most important factor considered in the ranking model is the effect on public safety associated with each specific backfit. However, while reduction in risk is an essential input, it is not an absolute indicator that a specific backfit is warranted as there will be some cases where the cost associated with a backfit is extremely large, or where a significant radiological exposure will occur during implementation.

Applicability to all Backfits

Another important consideration for the prioritization methodology is general applicability. The ranking model must have the capability to evaluate and rank all outstanding backfits, whether NRC initiated (typically topic numbered as 1.XX) or NU-initiated, (typically topic numbered as 2.YY). This requires the ranking model to be flexible and multi-faceted.

As a further example, PRA is a significant part of the ranking methodology. However, there are many issues that have been included in the program that are not readily amenable to direct PRA evaluation. Therefore, the ranking model

was developed to be equally sound and meaningful when the PRA or reliability input for an issue is either nonexistent or subject to large uncertainties. This, by definition, necessitates some amount of qualitative input. Plant operational experience data is utilized here as well.

Project Scoring and Evaluation

The ARM allows each potential plant improvement project to be scored and evaluated. The first phase of this process is scoring of the project's impact with respect to each individual attribute. The second phase, evaluation, follows scoring and involves a review of all attribute scores for the project and overall project results to assure consistency between attribute scores.

Individual impact scoring models for each attribute make the attribute definitions operational by establishing compatible analytical frameworks for evaluation and comparison. These frameworks are designed to efficiently define a score proportional to the determined benefit of the project for each of the attribute characteristics. For each attribute, the scores for all projects imply a relative ranking of projects with respect to that particular benefit dimension.

The "attribute impacts" are the difference between the pre-project implementation condition and the expected post-implementation condition; conditions associated with implementation only are treated separately through the cost function.

The scoring models developed for each of the approved attributes for the ISAP are summarized as follows:

- o Public Safety - This attribute scoring model estimates changes in public risk (in terms of Man-Rem) utilizing either quantitative calculations or engineering judgment; non-radiological public risk impacts are separately calculated, when applicable, on an equivalent hazards basis. The quantitative submodel is preferred when practical. This submodel calculates the change in public exposure risk proportional to the incremental change in core melt frequency multiplied by an effective public dose consistent with the type of core melt considered. Plant operational experience data is utilized in this attribute evaluation, as appropriate.

- o Personnel Safety - This attribute scoring model separately estimates changes in radiation exposure and in industrial safety risk, comparing conditions before and after the proposed modification. The installation impacts are separately estimated for inclusion in the cost function. The radiation impact (Man-Rem) is calculated using conventional ALARA-type calculations or estimates, as necessary. The industrial safety impact (lost man-days) is estimated following an analysis for potential hazards based on tables of frequency and consequences for representative hazards. The two subscores are combined into an overall personnel safety score. Plant operational experience is reviewed during these evaluations.

- o Economic Performance - This attribute scoring model estimates changes in equivalent unavailability (expected gain or loss of plant output in rated power hours per year), considering changes in reliability, availability,

maintainability and plant efficiency. The scoring analysis begins with a thorough review of possible plant states and of modification "impact states" to ensure complete consideration of project impacts. Pertinent plant operating experience is then reviewed and incorporated where applicable.

- Personnel Productivity - This attribute scoring model estimates the change in effective man-days of work produced, considering the proposed project's effect on people, their equipment and their work environment. The impacts are estimated based upon both quantitative and qualitative judgments. Impact on workload and training, for example, can be estimated in man-days, while those on maintainability, environment, communications or participative management require more qualitative evaluation. A checklist is used to ensure complete consideration of impacts. Separate subscores are summed to obtain the overall man-day impact.

Further details of each of the four attribute impact models are provided in Attachment 4.

Following project scoring, the next step in the ARM process is analytical evaluation and initial ranking. This formal evaluation ensures consideration of: 1) the potential impacts of one project on either the benefits of or need for another project; 2) the potential for redefining a project to retain positive attribute impacts (benefits) while eliminating negative ones (i.e., define an alternative); and 3) any other creative suggestions which may be stimulated by the evaluation process. Action items on project scope or specific scores often result from the discussion. Disposition of the action items result in a consistent set of scores and an approach for each project as responsive as practical to each of the attributes.

Subjective Weighting Factors

Weighting factors must also be applied to assign each attribute a relative influence on the overall project score. These subjective weighting factors enable management to exercise judgment regarding the relative importance of the various benefit criteria. Restated from a different perspective, these factors enable management to control the allocation of residual risk from the utility's nuclear program.

The subjective weighting factors used in the ARM were established via a survey of NU management with various responsibilities pertinent to the NU nuclear program. The survey utilized pair-wise comparisons among the four attributes (an analytical hierarchy approach). For example, had one attribute been ranked clearly more important than each of the other three, a relative weighting factor of 9:1 could have resulted. In fact, however, the largest actual relative weighting is 2.4:1 (Public Safety over Personnel Productivity). These factors are candidates for change and/or confirmation on a periodic basis, recognizing that corporate priorities may vary with time.

Subjective weighting factors provide the judgment of the relative importance of each of the four attributes. The following weighting factors have been developed.

Public Safety - 1.41
Personnel Safety - 1.34
Economic Performance - 0.70
Personnel Productivity - 0.55

At this point it should be noted that external impacts are not weighted and combined with the four attributes. Rather external impacts are utilized in the prioritization screening as an indicator of potentially sensitive issues, primarily with regulators. This decision is based upon previous sensitivity studies demonstrating that the very subjective external impacts attribute would otherwise be an unjustifiably dominant driving force in the rankings.

Integrated Project Scoring

Following scoring of the projects by the individual attribute evaluators, ISAP personnel process the scores. The processing applies the derived management weighting factors to calculate net benefit. Cost data (implementation dollars and Man-Rems) are then added so that benefit-to-cost ratios can be computed, leading to a first-cut ranking of the projects.

The total score for a particular project under consideration is determined by combining the sum of the products of the attribute scores times their respective weighting factors. The integrated score for a project (i.e., the summation) is thus represented as follows:

$$TPV = \Sigma S_i V_i$$

Where TPV = Total Project Value
S_i = Subjective Weighting Factor for Attribute i
V_i = Project Score for Attribute i (Equivalent Dollar Value)

Finalized Ranking of Benefit/Cost Ratios

The score review process has been designed to provoke critical review and to permit justified changes in project scores, while also including safeguards to prevent manipulation by individuals who might undercut process objectivity. Process features, such as the involvement of independent technical personnel in the assessment of each benefit dimension, contribute objectivity. The process relies on experienced judgment to improve both the project evaluation and the ranking where possible.

Individual scores for each of the attribute impacts are consolidated into an overall benefit score for each project. The best estimate information on remaining project implementation costs is combined with the overall benefit score for each project to produce a prioritized ranking of all of the projects based on a benefit-to-cost concept. This prioritized ranking is an important input into the PS phase of the ISAP process.

Prioritization Screening

Prioritization Screening (PS) is the next step in the development of the IIS. The PS considers the ARM initial ranking with additional consideration of other factors, including current installation man-rem, data on the payback of implementation costs, and management overview of the benefit/cost determination. During the PS, NNECO also subjectively considers the impact of external factors important to the project ranking. These external factors include, but are not limited to NRC actions and requirements, actions of state/local government agencies, actions of other federal regulatory agencies, and actions of industry organizations. These third party influences may dictate a higher or lower priority than would be indicated by the ARM alone. For example, NNECO is required to operate Millstone Unit No. 3 within NRC regulatory requirements. To the extent specific requirements are applicable and NNECO is not otherwise exempted, NNECO will rank and schedule the projects consistent with binding NRC orders and regulations.

Another important element of ISAP is the qualitative "threshold" concept, such that issues shown in the integrated assessment to be of little or no benefit will be deferred or dropped. This can occur, for example, if the proposed project has insufficient intrinsic benefit or if it is obviated by other projects which will be implemented. NNECO and CYAPCO consider candidate projects to be dropped during the PS. As a result, the final project rankings to be utilized in development of the IIS will include only those ISAP projects that have been specifically identified for implementation.

Integrated Implementation Schedule

Given the scheduled outage duration, NNECO initially selects projects to be completed based on the PS. If a high priority project a) can be supported by the necessary resources, including manpower, available man-rem, equipment, and dollars, and b) does not otherwise impact critical path for the outage, the project is scheduled. On the other hand, if a project or engineering study cannot be supported by resources, it must be deferred until such time as the necessary resources are available. If the project can be supported but would impact critical path, NNECO subjectively considers the issue based on the ARM assessments, external consideration, and other subjective factors, as indicated on figure 2.1, prior to making a decision. For example, based on the completed evaluations of attribute impacts and the overall score, NNECO decides whether the project is of such importance that it should override the outage schedule. If a project is deemed to be of such importance, it is scheduled and the outage extended. If not, the project is deferred for consideration in the context of the next scheduled outage or implemented in more than one phase.

The differences between defined project topics and engineering study topics cause them to be represented and treated somewhat differently in the ARM and also in the IIS. Project topics are represented on the IIS graphic with cross hatched horizontal bars. Engineering studies, by contrast, are differentiated by non-cross hatched bars. These engineering studies are not typically processed through the ARM, prior to their completion. If the study results in a proposed plant modification, then the proposed modification is

evaluated utilizing the ARM process. The IIS, depicted in this first submittal, represents implementation dates for only those projects for which ARM evaluations have been completed. As more topics undergo cyclic ARM evaluations, their respective implementation status will be included in the IIS. As this cyclic process continues, the comprehensiveness of the IIS will correspondingly increase.

Typically high ranking topics would be scheduled within the IIS to be accomplished within one or two refuel cycles. Moderate ranking topics would normally be scheduled to be accomplished within two to three refuel cycles. Lower ranking topics would be scheduled accordingly or dropped. Engineering studies, previously discussed, are scheduled according to urgency and available analytical resources.

The IIS decision-making process incorporates management overview and the potential for multi-unit integration. This latter factor will ultimately enhance Northeast Utilities' capability to fully coordinate and optimize utilization of resources across all of its nuclear power plants.

Docket No. 50-423
B13436

Attachment 4

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program

Current Analytical Ranking Methodology

May 1991

Current Analytical Ranking Methodology

This attachment contains five sections which describe the specific details of the ARM process. The first four sections describe in detail, the four ARM attribute models:

- Public Safety Impact Attribute
- Personnel Safety Attribute
- Economic Productivity Attribute
- Personnel Productivity Attribute

The fifth section contains the Integrated Safety Assessment Program Evaluation Checklist, which is utilized to collect information from the project engineer (PE) on the proposed project assignment (PA). This checklist, when completed by the PE, is forwarded to the individual attribute evaluation personnel. The evaluators utilize the information contained in (and attached to) the checklist as the basis of their respective evaluation.

PUBLIC SAFETY IMPACT ATTRIBUTE METHODOLOGY

This section contains information relating to the basis and application of the Public Safety Impact Attribute Model for the Northeast Utilities ISAP.

Specific information is provided for the following items.

o The Public Safety Impact Attribute definition.

o A description of the Public Safety Impact Attribute Model.

ATTRIBUTE DEFINITION

The Public Safety Impact Attribute Model is defined in terms of the net change in public safety associated with the operation of the nuclear power plant, attributable to the implementation of a proposed project. Specifically, the current Public Safety Impact Attribute Model assesses a project's impact on the core melt frequency and its associated radiological risk to the public.

Standard Time Frame Over Which to Assess Impact

In order to ensure that the impact scoring of projects is repeatable and traceable, the impact of every project must be assessed with respect to the expected changes in risk occurring over some standard time period. Therefore, the public safety impact is calculated as a total for the remaining life of the plant. This total is then divided by the number of years remaining in the plant life to derive an annual public safety value. This provides a value that is on a comparable scale (i.e., annual) to the other attribute model results.

PUBLIC SAFTY IMPACT ATTRIBUTE MODEL

The public safety impact evaluations of individual projects is accomplished using one of three methods discussed below.

Method A: Direct Quantification

The impact on public health and safety due to implementation of a project is explicity calculated using probabilistic risk assessment (PRA) techniques. The base case for the calculation is the plant-specific Probabilistic Safety Study which is used to measure the core melt frequency impact of the project considered.

Method B: Engineering

For projects in this group, engineering judgment based on knowledge and engineering insights gained from a Probabilistic Safety Study is used to determine the project influence on the public risk. This method is chosen for projects upon which quantitative calculations cannot be readily done via PRA techniques.

Method C: Quantification of Equivalent Risk Impact

Some projects may involve hazardous (non-radiological) materials. For such projects, a change in public risk is calculated either by a satellite PRA model or engineering judgment. While these projects can directly affect public health and safety, the change in calculated core melt frequency is also considered if applicable (example, impact on control room habitability of hazardous gas release on-site).

All ISAP projects are ranked on a linear dollar scale to provide a hierarchy among the various projects in terms of man-rems and/or core melt frequency change. The following is a general description of the three methods that are used to evaluate the projects.

METHOD A: DIRECT QUANTIFICATION

For this method, it is assumed that a probabilistic risk assessment (PRA) has been performed for the plant and that included in the PRA is an uncertainty analysis. The mean core melt frequency and dominant contributors to risk are identified. Initiators were updated utilizing operational experience data. It is also assumed that there are a finite number of plant backfits or operational changes under consideration and that it is desired to assign a ranking to each one.

The methodology is as follows:

The change in core melt frequency (or the plant damage state (PDS) frequency) is calculated either by performing sensitivity studies with the existing Probabilistic Safety Study or by developing a separate satellite model. All of the calculations took the following items into consideration:

- o any new initiators that were created by the projects

- o any project impact on the mitigating system unavailabilities
- o any new core melt sequence that could be generated
- o any project not affecting core melt frequency, but impacting the availability of containment heat removal or the containment leakage rate.

The resulting change in PDS frequency was then converted into a dollar benefit value representing the change in public risk by the following equations:

$$R = TK_1 \Sigma_i \Delta (P_i \times C_i) \qquad (1)$$

where R = total dollar benefit value representing the change in public risk, (dollars)

T = Remaining Plant Life (years)

K_1 = Cost of a person rem ($1000/man-rem)

P_i = The frequency of the i^{th} PDS (per year).

C_i = the offsite public consequences associated with the i^{th} PDS (Man-Rem)

Hence, $\Delta(P_i \times C_i)$ represents the change in the offsite consequences per year associated with the i^{th} PDS.

Equation 1 is the general form of the equation used when a project effects both the frequency of PDS(s) and the consequences. In pactice, projects affect primarily the frequency of the PDS (e.g., improvement of auxiliary feedwater or containment spray reliability) or the consequences (e.g., installing additional containment isolation valves on lines penetrating containment). Equation (1) can then be approximated by:

$$R = TK_1 \Sigma_i \Delta P_i \times C_i + TK_1 \Sigma_i \quad P_i \times \Delta C_i$$

where the first term is used for the projects which affect only PDS frequencies, while the second term is used only for projects affecting offsite public consequences (given a core melt sequence). It should be noted that some projects such as those affecting the reliability of containment heat removal systems may have <u>no</u> measurable impact on core melt frequency, but may alter the relative frequencies of the PDS (i.e. $\Sigma_i \Delta P_i = 0$).

The proposed projects are assigned two dollar scores based upon the estimated impact on core melt frequency as well as the radiological risk to the public. The reason for this assignment is that some proposed projects could significantly impact core melt frequency and yet have little measurable effect on offsite public risk. This is apparent for accident sequences where containment heat removal systems remain intact. Other projects might have large impacts on public risk, but relatively low impact

on overall core melt frequency (for example, LOCA outside containment). Therefore, the following is used:

TOTAL DOLLAR BENEFIT SCORE	=	PUBLIC RISK SCORE	+	CORE MELT FREQUENCY SCORE

A decrease in public risk is assigned a positive dollar score. A zero score implies no change in public risk, and a negative dollar score implies an increase in public risk. The end result is that for each proposed plant backfit, a total dollar benefit score will be determined, in units of dollars.

METHOD B: ENGINEERING JUDGMENT

Not all projects will be amenable to a direct numerical quantification of change in core melt frequency and thus public risk. For these types of projects, the project score is assigned by engineering judgment based on knowledge and engineering insights gained from a PSS. An important factor in scoring such projects are comparisons to other projects which have attributes allowing a direct quantification (Method A) of change in core melt frequency. A good example would be a project which provides a human factors enhancement. The PSS models can be used to directly quantify the impact of the first project, but only allow limited insights into the significance of the second.

If the first project without any additional human actions virtually eliminates a number of accident sequences, whereas the second possibly reduces operator confusion, but does not guarantee success, it is reasonable that the second project should be scored significantly less than the first. By performing several such project-to-project comparisons, a judgmentally based dollar score can be determined.

METHOD C: QUANTIFICATION OF EQUIVALENT RISK IMPACT

Projects whose implementation would not produce a change in the plant's core melt frequency, but do impact the health and safety of the public, are evaluated by this method in one of two ways:

a. Public risk is directly calculated through a satellite PRA model and converted to an equivalent(*) man-rem exposure. This allows ranking of the project on an equivalent dollar scale.

b. Public risk is directly evaluated by engineering judgment and the project is then given an estimated dollar score for scale ranking purposes.

*Note: In converting the quantified public risk from the satellite model into man-rem, both severe adverse health effects and deaths are equated to latent fatal cancers due to radiation exposure.

PERSONNEL SAFETY ATTRIBUTE MODEL

This section contains the information to implement the Personnel Safety Attribute for the Northeast Utilities ISAP.

Specific information is provided for the following items:

- o The definition of the Personnel Safety Attribute.
- o The basis of the Personnel Safety Impact Model.
- o Recommended approaches for use of the model in both objective and subjective scoring processes.

The proper application of the Personnel Safety Attribute Model as described in this document requires judgment and experience. In either the objective or subjective scoring mode, it is important that the responsible personnel selected to exercise the model be well-versed in the general aspects of the design and operation of nuclear plants and understand or have access to pertinent information regarding applicable safety requirements under which plant operations are permitted.

ATTRIBUTE DEFINITION

The Personnel Safety Attribute is composed of two distinct elements representing the major hazard or risk areas associated with personnel activities within the site boundary of any nuclear power plant. These elements are the occupational radiation exposure and the industrial safety hazards associated with activities affected by the implementation of proposed projects. In terms of measurable quantities that are normally used to express risk (consequences) for each element, the definition of the impact of any project's implementation is:

> The change in on-site radiation exposure potential measured in man-rem for employees and contractor personnel resulting from the proposed implementation of the project
>
> \- plus -
>
> The change in industrial safety risks measured in potential lost workdays for employees and contractor personnel resulting from the proposed implementation of the project

Note that the impact is the difference in man-rem and industrial safety risks between the preimplementation situation and the expected postimplementation situation for the day-to-day activities associated with operating the nuclear plant.

Standard Time Frame Over Which to Assess Impact

The impact of a project must be assessed with respect to the expected change in man-rem and industrial safety risk expected over some specific time period representative of the projected future risk situations. In order to limit the complexity of the scoring process, it is generally easier to assess the impact of a project over a short time period, within which all significant risk situations for both elements are captured. Therefore, the occupational exposure and industrial safety values were calculated for a normal plant operating cycle. This value is then adjusted to derive an annual value that is on a comparable scale to the other attribute model values.

OCCUPATIONAL EXPOSURE MODELING

The occupational exposure model is mathematically represented by:

Delta (OE) = expected man-rem exposure due to normal operational activities after project implementation

- less -

expected man-rem exposure due to normal operational activities before project implementation

In order to quantitatively assess the value of each individual term above, it is necessary to determine the types of activities affected by implementation of the project, the location (an radiation field intensity) for each activity affected, the number of personnel required to perform each activity, and the expected (average) stay time of these personnel in the radiation fields at each location. This information must be available for both the preimplementation and the postimplementation cases. The net increase or decrease in projected exposure over the reference time frame is the basic impact parameter for this element of the Personnel Safety Attribute Impact model.

Value Conversion

To support the determination of the total value of a project, it is necessary to express the attribute impacts of all projects in terms of a common unit of measurement. The most easily determined measure in which the value of man-rem exposure to the utility can be expressed in dollars.

The expected change in exposure associated with the implementation of a project is converted into dollars by use of the relation:

1 man-rem exposure = $1000

This is the nominal value for occupational exposure used by Northeast Utilities and throughout the nuclear industry.

Assessment of Implementation Costs

For the implementation of a project, it may be necessary to expose personnel to some level of radiation during installation. This exposure is treated as a

cost of implementation as previously mentioned, since it is a one-time rather than continuing exposure situation.

The cost of exposure associated with implementation is most simply converted to dollars by the use of the conversion factor:

1 man-rem = $1000

This dollar value can then be added directly to the budgetary cost of the project before evaluating the benefit/cost ratio to obtain a more meaningful assessment of project viability.

For projects specifically implemented to reduce radiation exposure over the remaining life of the plant, a comparison of the installation exposure in man-rem with the expected exposure savings over the plant lifetime is also a useful means of gauging project viability.

INDUSTRIAL SAFETY MODELING

Modeling for the industrial safety element of the Personnel Safety Attribute is somewhat more complex than for the occupational exposure element. Since the types of risks to be assessed here are generally associated with the random failures of equipment and accidents associated with plant tasks, it is rather difficult to define and exercise an objective model at a useful level of detail. As such, a subjective scoring process for this particular element of the model is more suitable than the objective process developed for the occupational exposure element, where the evaluation of the change in man-rem exposure is much more deterministic.

All risks for this element can be expressed in terms of lost workdays, which has been selected as there is an available value conversion directly from this measure to dollars. The value recommended for use herein is derived from data for many utilities and is equal to $600 per lost workday.

As direct quantification of the industrial safety impact of a project is not easily obtained, the scoring process relies on the subject judgment of the individual(s) evaluating the proposed project. The scoring process entails qualitatively estimating the likelihood and consequences of a hazardous event occurring or being avoided due to the implementation of a project. These qualitative measures are then converted into quantitative measures to obtain a numerical estimate of the value of a project.

The process is as follows:

1. The likelihood of a hazardous event occurring or being avoided due to the implementation of a project is qualitatively estimated as being frequent, moderate, unlikely, extremely unlikely, or none. Utilizing the ranges displayed in Table 1, this qualitative estimate is converted to a quantitative estimate of the frequency of occurrence per operating cycle.

2. The effect of a hazardous event occurring (or being avoided) due to the implementation of a proposed project is qualitatively estimated as being critical, severe, moderate, minor, or none. Utilizing Table 2, this

qualitative estimate is converted to a quantitative estimate of the effect of a proposed project in estimated lost workdays per individual.

3. The number of affected individuals due to the implementation of a proposed project is qualitatively estimated.

4. The multiplicative product of the estimated frequency of occurrence per cycle, the estimated effect, and number of affected individuals results in the estimated total number of lost workdays (prevented or incurred) per cycle due to implementation of the proposed project.

Value Conversion. As previously noted, the recommended relationship for converting the physical measure of lost workdays into dollars of worth or value is:

1 lost workday = $600

The conversion must be reevaluated on a regular basis in order to maintain the accuracy of the relationship. This value is greater than the cost of a normal personnel workday (approximately $250), because it includes additional costs such as supervisory time to investigate accidents, etc.

Assessment of Implementation

There may be industrial safety risks associated with project implementation activities, which can be assessed by application of the models just described or through direct performance of a job safety analysis. These risks, being associated only with implementation, are effective costs. They can be converted to equivalent dollars and then be summed with the budgetary and implementation exposure costs for use in project ranking.

SCORING PROCESS

For each individual project, the scoring process is simply the summation of the occupational exposure and industrial safety impacts. A summary of the scoring process is attached.

PERSONNEL SAFETY IMPACT ATTRIBUTE MODEL
SCORING GUIDELINES

1. Collect required information by use of evaluation checklist and personal contact.

2. Assess occupational exposure impact of project (change in expected dose commitment for program personnel over one standard operating cycle) for all normal activities affected by the project. Use an ALARA Job Review if appropriate. Convert the estimated magnitude of the net change to dollars. Assign (+) sign if net change in exposure is a decrease; assign (-) sign if an increase.

3. Assess industrial safety risk impact of a project (change in risk of industrial safety hazard for program personnel over one standard operating cycle) for all affected normal activities. Use a Job Safety Analysis if appropriate. Use Tables 1 and 2 to convert the magnitude of the estimated risk change to an estimated dollar value. Assign (+) sign if risk decreases; assign (-) sign if it increases.

4. Calculate the total Personnel Safety Impact score and equivalent project worth by summing the occupational exposure impact (Step 2) and the industrial safety impact (Step 3). This value is then adjusted to an annual value that is on a comparable scale to the other attribute model results.

Table 1

Evaluation of Hazardous Event Frequency

Likelihood	Frequency (1/Cycle)
Frequent	Greater than 0.5 (Nominal: 0.5)
Moderate	0.07 to 0.5 (Nominal: 0.3)
Unlikely	.01 to .07 (Nominal: 0.04)
Extremely Unlikely	Less than .01 (Nominal: 0.005)
None	0.0

Table 2

Evaluation of Generic Hazardous Event Consequence

Estimated Effect on Individual	Type of Injury Per Year	Estimated Lost Workdays Per Individual
Critical	Death, Blindness (Any Permanent Disability)	Greater than 200 (Nominal: 200)
Severe	Loss of Limb Vision Impairment	40 to 200 (Nominal: 100)
Moderate	Broken Limb Loss of Digit	5 to 40 (Nominal: 20)
Minor	Localized Burn Sprained Ankle	Less than 5 (Nominal: 3)
None		0.0

ECONOMIC PERFORMANCE ATTRIBUTE MODEL

This section contains a description of the Economic Performance Attribute for the Northeast Utilities ISAP.

Specific information is provided for the following items:

- The definition of the Economic Performance Attribute;
- The Economic Performance Attribute Model scoring process.

The implementation of the Economic Performance Attribute Model is supported by and fully described in the Northeast Utilities Reliability Engineering Department Report Number 1301492.

ATTRIBUTE DEFINITION

The Economic Performance Attribute is composed of four major elements representing the major components of traditional plant reliability analyses. These elements are the reliability, availability, and maintainability of the plant, and a loss of plant output component. These elements are used to measure the effect of a proposed project on plant performance. The specific definitions of each element are:

- Availability--Availability is intrinsically defined as the probability that a system is operating satisfactorily at any point in time when used under stated conditions. The time considered includes the operating time and the active repair time. Operationally, the definition is often tailored to support mutually agreed-upon conditions.

- Reliability--Since one way a system can become unavailable is to fail, reliability enters as a component of availability. Reliability is defined as the probability that a system will perform for at least a given period of time when used under stated conditions.

- Maintainability--Because the length of time a system is down for maintenance or repair affects its unavailability, its maintainability characteristic must be measured as a contributor.

  Maintainability has been defined as the probability that a failed system is restored to operable condition in a specified downtime. In practice, the downtime may be for test, regular maintenance, or for repair of a failure.

- Losses of plant output--Losses in plant output introduces the notion of capacity changes where a system is operating at less than its possible capability. Operationally, these losses in output are termed deratings or losses in efficiency.

These four elements are related together as a quantitative measure of equivalent plant availability which is used as the basis for the economic performance attribute scoring.

Standard Time Frame Over Which To Assess Impact

The impact of a project must be assessed with respect to the expected change in equivalent plant availability expected over some specific time period representative of projected future plant operating scenarios. In order to limit the complexity of the scoring process, it is generally easier to assess the impact of a project over a short time period, within which all significant plant operating scenarios are captured. Therefore, one calendar year is used as the basis for impact scoring against each attribute. This is the standard time scale for all of the attribute model values.

ECONOMIC PERFORMANCE MODELING

The Economic Performance analysis is a systematic approach to evaluating and estimating the impact of a plant change on the performance of the plant. The measurement of the plant's performance is called equivalent availability. The "system" which defines the equivalent availability is the plant output cycle which is the power generation cycle for an electric generating plant.

The analysis seeks to determine how a proposed change will affect plant performance as measured by equivalent availability. The investigation is conceptually performed in tiers as follows:

1. Phase I: Systems Analysis or Qualitative Analysis--Systematic identification of the logical relationship of the proposed change on the plant's power generation cycle.

2. Phase II: Quantitative Analysis--Using either subjective and/or objective models, a quantitative estimation of the impact that a proposed change will have on the plant's performance; i.e., equivalent availability, is developed.

3. Phase III: Value Conversion--Conversion from units of equivalent availability to the common unit of measurement (dollars) utilized for integration with other ISAP attributes.

Quantification of the impact on power generation (plant equivalent availability) from a potential modification can be performed by using an objective impact model, a subjective impact model, or both. The objective impact model uses a plant availability logic model, in which plant availability is related to the availability of its systems, and the operation of these systems are related to the availability of their components. The subjective impact model is a process by which the impact of a modification on the power generation process is estimated on the premise of insufficient analytic data on the reliability, and maintainability of proposed changes. This process, uses a mixture of expert judgement and historical data in determining the expected impact on a plant's equivalent availability.

Objective Impact Model

It is important to recognize that there is no single one availability analysis model which is valid for all scenarios. The model chosen always depends on the nature of the problem and the form of the results. Here, two models, the plant availability model and the inductive model, are described.

o <u>Plant Availability Model</u>

The plant availability model is a logical structure which connects all elements in the power production cycle in such a way that if the performance of the individual component is known, the expected overall plant performance can be quantitatively evaluated.

In this model, the measure of performance for each component is defined in terms of:

- Failure rate,
- Time to restore following the occurrence of failure, and
- Capability.

For complex situations where the impact on the effected system is not easily calculable, the UNIRAM code will be used.

o <u>Inductive Model</u>

There are occasions when a specific analytical model is unnecessary for evaluating the impact of a modification. For example, in the case of a condenser retube, one can easily evaluate the total megawatt-hours lost due to condenser tube leakage from plant operating experience record. If retubing modification of the condenser could eliminate the tube leakage, then the net benefit from its implementation is easily calculable.

Other equipment-caused forced (or scheduled) reductions and/or outages could also be evaluated similarly. The process to evaluate the effect of component-caused curtailment is as follows:

1. Collect information on outages and reductions caused by the equipment under study and evaluate the attributed megawatt-hours (MWhrs) loss.
2. Evaluate the equivalent full-power hours lost by dividing the Mw-hrs calculated : No. 1 by the net electrical rating of the plant.
3. Divide the result of No. 2 by the total period of hours for which the data in No. 1 were collected.
4. The result of No. 3 is equivalent availability loss.

o <u>Component Performance Definition</u>

Quantification of the plant availability model requires performance measures for each modeled element in terms of its:

o Failure rate,

o Time to restore given failure, and

- o Capability.

These performance parameters are determined through a different set of inductive models which result from:

- o Reliability analyses of components--estimates of failure rate.
- o Maintainability analyses of components--estimates of failure rate.
- o Maintainability analyses of components--estimates of time to restore.
- o Hydraulic or thermodynamic analyses of components--estimates of component capabilities.

Performance parameters can also be determined from historical or empirical evidence which is reflected by data collected over some preceding period(s) of plant operation.

o <u>Sources of Data</u>

Two sources of data are used for quantification of the plant model: plant-specific and industry data.

Plant-specific data has the advantage of reflecting actual historical performance and in most cases will be an adequate predictor of future performance of the plant if the data is carefully collected. However, this data has limitations since it does not always account for:

1. Failure rates which have changed over the life of the plant as a result of corrective action or where new failure modes have been exposed. This change leads to the need for examination of the temporal nature of data and elimination of some data which will no longer be applicable for calculating near future performance.

2. Failure rates can be distorted by "shadowing"; i.e., failures which are repaired during other scheduled outages without being included in the data base. These failures do represent a risk, and must be accounted for. Otherwise, if other plant outages are reduced by making improvements, the effects of shadowed failures will become more pronounced. If the shadowed data is not accounted for, its use could result in a higher plant performance prediction than the plant actually could gain.

Industry data has the disadvantages that it may include failures which are not appropriate for the plant under analysis. The use of industry data results in a less accurate prediction of absolute levels of a plant's historical performance than with the use of plant-specific data. But, on the other hand, industry data has the advantage of being a better predictor of expected improvements and future performance levels which result from proposed changes.

Subjective Impact Model

The subjective impact model is a quick process for prioritizing a set of possible modifications in order to determine which will have the most impact on the plant's availability.

This impact model is applied to those modifications where the information on the performance measures of the proposed changes are unavailable. The model is based on a few, if available, statistics. Although the uncertainty associated with the subjective model is large compared to the objective model, decisions regarding improvement options can still be made.

As discussed earlier, the plant performance characteristic considered is plant equivalent availability. The significant plant variables affecting this characteristic are the frequency and duration of a given outage/reduction type, and the pattern in which the outage/reduction occurs.

In the subjective impact model the potential improvement impact of a proposed modification are estimated as follows:

1. Perfect Improvement - Approaches a complete elimination of the existing problem.

2. Medium Improvement - Significant reduction in existing problem.

3. Low Improvement - The modification marginally changes the existing plant performance.

4. No Improvement - The modification does not change the existing plant performance.

5. Negative Improvement - The modification could cause detriments.

For the ranking process, these results are benchmarked and adjusted for consistency consistent with the corresponding results from the objective model.

Value Conversion

The final result of each modification benefit or loss on the power generation process is in terms of change in equivalent full-power operation days. The evaluation outcomes are in terms of equivalent availability (objective model) or qualitative estimates (subjective model), both of which are translated into equivalent days of full-power operation.

To support the determination of the total value of a project, it is necessary to express the attribute impacts of all projects in terms of a common unit of measurement. The most easily determined measure in which the value of the ISAP attributes can be compared is dollars. Once all the impacts are evaluated, either objective or subjective, they are converted to dollars utilizing the current Northeast Utilities cost of replacement power dollar value for an equivalent day of full power operation at the nuclear plant being evaluated. This value will be reassessed periodically as economic situations warrant.

PERSONNEL PRODUCTIVITY ATTRIBUTE MODEL

This section contains information relating to the basis and application of the Personnel Productivity Attribute Impact Model for the Northeast Utilities ISAP.

Specific information is provided for the following items.

- o The Personnel Productivity Attribute definition, including the incorporation of direct and indirect (quality of work and work life) aspects.
- o A logical structure for systematically assessing the major components of productivity impact associated with proposed projects.
- o A description of the Personnel Productivity Attribute Impact Model based on the definition and logical structure provided herein.
- o Guidelines concerning the scoring processes for projects against the Personnel Productivity Attribute.

ATTRIBUTE DEFINITION

The Personnel Productivity Attribute is defined in terms of the net change in personnel productivity associated with the operation of the nuclear power plant, attributable to the implementation of a proposed project.

Specifically, the Personnel Productivity Model assesses the productivity impact of a proposed project by evaluating three major areas:

1. Effects on people.
2. Effects on equipment/tools.
3. Effects on the work environment.

Standard Time Frame Over Which to Assess Impact

In order to ensure that the impact scoring of projects is repeatable and traceable, the impact of every project must be assessed with respect to the expected changes in productivity occurring over some standard time period. In order to simplify the scoring process, it is generally easier to consider the productivity impact of a project over a short time period, which contains all significant different types of work activities affected by the implementation of the project. Therefore, one calendar year is used as the basis for impact scoring against each separate attribute. This is the standard time scale for all of the attribute model values.

PERSONNEL PRODUCTIVITY MODELING

There are three basic elements of change associated with the activities of any organization: its <u>people</u>, the <u>tools and equipment</u> they use to perform their activities, and the <u>environment</u> in which they must work. To predict the combined productivity impact of any project, it is necessary to assess, for each observable or tangible component of each element of change, an expected

impact level (either direct or indirect) in terms of some measurable quantity, such as change in total effort required over the standard refueling cycle.

Assessing Direct Impacts on Productivity

A proposed project can affect the throughput of products and services by affecting either the type of service provided, the amount of service provided, or the level of effort required of groups and individuals in the organization. The direct effects on observable features of the nuclear organization's elements of change are as follows:

People--A project could directly affect the level of effort or amount of work required to provide services in two major categories:

a. Work load--The proposed project may involve the need to use equipment that requires additional routine maintenance, calibration, testing, or surveillance. Or it could reduce the need for such activity. All such activities should be considered, as they impact all affected personnel. The baseline case is the situation prior to implementation. The net change in effort required to perform all activities is to be determined. If net work load is reduced, the impact of the project is beneficial.

b. Training--The proposed project may involve requirements for increased routine training or it could remove the need to provide certain types of training. The net change in effort required for training over the reference time frame should be evaluated here. A net increase in required training time is nonproductive and considered a negative against this particular category.

The enhancement of personnel performance through training is a quality-related issue that indirectly affects the number of man-hours required to provide the service or function. The expected improvement in personnel performance may be so significant as to cancel out the effect of the additional training time. This latter aspect of productivity impact is actually an indirect impact and should be evaluated and have its effect quantified under that category of impact rather than in the training category.

Tools and Equipment--A project could affect the plant equipment or tools and testing instruments used by nuclear program personnel or could result in the placement of equipment which must be maintained, repaired, or tested in locations that are physically difficult to access.

a. Complexity--Changes to the operating units or new requirements for analysis or licensing may increase the complexity of equipment or processes necessary for continued support of plant operations.

b. Physical Accessibility--Changes to the layout or physical structures of the operating plants may affect the accessibility of areas where work activities such as calibration, inspection, maintenance, and testing must routinely take place. Additional time involved with obtaining access when performing these activities is a direct negative productivity impact. The possible effects of increased

security precautions should be assessed against this portion of the productivity attribute.

<u>Environment</u>--This area describes the direct impact of the working environment on the productivity of personnel performing duties to support the nuclear organizations. It includes location effects (changes to the distance between "home base" and work location for routine work efforts of groups or individuals) and the directly felt effects of environmental factors such as heat, noise, radiation fields, etc., on the level of effort required to accomplish a particular package of work.

a. <u>Location</u>--Projects may change the relative locations of group or individual "home bases" and the locations where their assigned tasks are to be performed. Changes such as these directly affect the productivity of the involved personnel because of the need to expend paid time in greater amounts of travel between working locations and "home base." Increased travel time requirements are reductions to productivity.

b. <u>Other Environmental Factors</u>--Projects can result in changes to the plant that limit or increase the amount of time any one individual may be able to remain in a potentially hazardous environment such as a work area which is placed in a high- or low-temperature zone, a region of low air quality or toxic atmospheric conditions, a radiation field, or a noisy location. This may entail a change to the number of individuals required to complete a particular work effort. Effects such as these cause a direct impact on the level of effort required. Changes to the effectiveness or performance of personnel at work caused by the presence of environmental stressors at the work location should be evaluated separately as a quality-related productivity issue.

<u>Assessing Indirect Impacts on Productivity</u>

In addition to the direct project impacts on personnel productivity that change the amount of effort or level of effort required by program personnel, there are also indirect impacts that typically affect personnel performance and, therefore, the quality of their services and functions.

Components of the elements of change which can indirectly impact the productivity of the nuclear organization are as follows:

<u>People</u>--Projects may indirectly affect the productivity of organization and its personnel through possible impacts in two basic areas within this element of change.

a. <u>Personal Development and Training</u>--Projects which enhance the work skills and basic understanding of personnel contribute to increases in the quality of individual and group performance. Implementation of a project without sufficient training of individuals required to use a new process or piece of equipment associated with the project increases the risk that productivity will decline because performance will decline.

b. Communications--Projects which enhance the capability of portions of the organization to communicate with one another concerning their tasks and responsibilities increase the performance potential and productivity of the organization. Increased communication potential is the key to improved employee and group understanding. Project impacts on both operational and organizational communications are included and should be considered in this area. Changes to communication potential cover changes both to communications processes and communications equipment.

Tools and Equipment--The performance of individuals and the organization as a whole can be affected by projects which impact the way tools and equipment are used by personnel in support of nuclear power plant operations. If up-to-date equipment and processes are provided and are well maintained as a matter of policy by the nuclear organization, individual, group, and plant performance and productivity are each maximized. The additional time taken to maintain equipment to a higher level than nominally required, or to continually update procedures and processes as needed changes are identified, may be considered by some to be a first-order productivity reduction. There is, however, accumulating evidence from domestic and foreign nuclear power experience that the most successful nuclear operating organizations are those which without fail maintain their equipment, tools, and processes. Hence, the net effect of the additional time taken to ensure proper maintenance appears to be beneficial to productivity and performance.

Environment--Projects that affect the surroundings in which groups and individuals within the nuclear organization must perform their assigned tasks can also affect productivity.

a. Stressors--The presence and intensity of physical and psychological stressors such as extremes of temperatures, time clocks associated with equipment repair or maintenance, etc., can impact the performance and productivity of personnel. These effects are separate from, although related to, the effects of such environmental concerns on the amount of time any single individual can spend in a given area performing a necessary task. They generally appear as effects on the rate of errors in performing the required tasks.

b. Surroundings--The facilities in which personnel must work are another factor that can shape performance and productivity. Projects that improve the physical surroundings (buildings and grounds) of nuclear program personnel can help to improve productivity. Effects of projects in this area can be very subtle and almost inconsequential when considered on an individual basis; when considered as continuing impacts on all personnel on a day-to-day-basis, changes to the normal work surroundings resulting from project implementation may have a major impact on the overall productivity of the nuclear organization.

SCORING OF PRODUCTIVITY IMPACTS

The final output (attribute impact score for each project) of the Personnel Productivity Attribute Impact Model is desired in terms of a quantitative measure of personnel effort change, such as the number of workdays per year saved or lost due to implementation of the project.

Many of the direct and indirect impacts that affect productivity through individual performance or quality of product cannot be objectively quantified in terms of personnel workdays saved or lost in this manner. It is necessary for an experienced individual to make judgments to determine the level of productivity impact expected through consideration of the performance or quality-related effects of the project.

The approach to obtain quantitative estimates of impacts is the use of a set of qualitative verbal descriptors that are correlated with representative values of impact in workdays saved or lost per calendar year to obtain a numerical estimate of the value of a project.

The use of the qualitative verbal descriptors to assess the expected productivity impact of a project or certain aspects of a project is generally required at all times for measuring components of productivity.

There are four different levels of impact used. These are in decreasing order of magnitude: significant, moderate, minimal, and inconsequential. Each level is associated with a specified amount of change in the number of personnel workdays required to support the operation of the nuclear plant over one calendar year. Considerations in determining the qualitative productivity impact of any project on overall productivity, a single element of change, or an isolated component of any element of change are the frequency of the activities being affected, the number of individuals associated with these activities, and the time involved per individual in each occurrence of the activity. The direction of the productivity impact is either negative (reduces productivity) or positive (increases productivity).

The expected productivity impact due to the implementation of a proposed project is qualitatively estimated for each component (work, people, equipment) as being significant, moderate, minimal, or inconsequential, or none. Utilizing the ranges displayed in Table 1, these qualitative estimates are converted to a quantitative estimate of the productivity impact for each component and combined to arrive at an overall project rating.

One personnel workday is defined as the effort provided by one member of the nuclear division organization over one standard workday.

A significant impact is one that involves a large number of personnel, is performed frequently, and where the time involved in the activity is extensive.

Moderate productivity impacts are those which will show less total productivity change than for a significant impact while still being measurably large.

Minimal productivity impacts are associated with minor changes to equivalent level of effort. They are impacts that are considered to be measurable and

observable while not changing the organization's productivity in any major way.

Inconsequential productivity impacts are those productivity impacts that can be projected as a result of the implementation of a project, but which are expected to be very limited in extent and therefore difficult to observe and measure.

Value Conversion

The relationship between one personnel workday of effort in the Northeast Utilities nuclear program and the dollar value of this effort is used to describe the productivity worth of a project in the ISAP. The present value of this conversion factor is:

1 personnel workweek = $1280

This conversion factor must be reevaluated on a regular basis in order to maintain the accuracy of the conversion to dollars of value.

Table 1

PERSONNEL PRODUCTIVITY ATTRIBUTE
SCORING GUIDELINES

Estimated Qualitative Impact	Estimated Quantitative Impact (Per Calendar Year)
Significant	Greater than 52 personnel workweeks (nominal: 52)
Moderate	13 to 52 personnel workweeks (nominal: 30)
Minimal	2 to 13 personnel workweeks (nominal: 8)
Inconsequential	Less than 2 personnel workweeks (nominal: 1)
None	0

Date: ____________

INTEGRATED SAFETY ASSESSMENT PROGRAM
EVALUATION CHECKLIST

Unit: ☐ CY ☐ MP1 ☐ MP2 ☐ MP3 PA No. ____________ ISAP Topic No. ____________

Title ____

____

Project Engineer ______________________ Plant Engineer ______________________

Project Stage:

☐ Initiation ☐ Preliminary Engineering ☐ Engineering & Design ☐ Construction

Proposed Change/Project ____

____

____

____

____

Reasons for Change/Project (specify objectives and regulatory commitment/bases, IE Bulletins, NUREGs, 10CFR [GDC, Appendix J, R, etc.], GL, ISI, PRA-IPE, Related ISAP Topic, etc.).

____

____

____

____

____

____

____

____

References (specify letters, memos, etc.) ______________________________

____

I. Public Safety (to be utilized by PRA analyst)

1. Which system(s) are affected by the proposed project/modification?

____

____

2. Do any of the system interfaces change (e.g., power supply, HVAC, etc.)?

____

____

3. Explain safety-related implications of change.

____

____

4. Has any safety analysis been performed to support the change? What were the results?

____

____

5. Does the proposed change increase the frequency of a transient (trip, etc.) equipment failure, or system failure? (If yes, then explain.)

____

____

6. Explain, in detail, how the proposed change will enhance plant response to an accident and/or improve plant operation ("this PA will increase safety and improve plant operation" is not sufficient to allow PRA analysts to perform the evaluation).

____

____

____

____

II. Economic Performance (to be utilized by Reliability Engineering analyst concerning how a proposed modification effects this units ability to generate power).

1. Which characteristic most accurately describes the effect of the existing system/component on the plant?

☐ Availability ☐ Efficiency ☐ Derating ☐ Thermal Capacity ☐ None

Explain ____

____

____

2. The frequency of outage without the proposed modification is expected to be:

□ High (≥ 8 events/year) □ Medium (1 event/year) □ Low (1 event/10 years)

□ Other ______________________________

3. Probable outage type:

□ Forced Outage □ Forced Reduction □ Scheduled Outage □ Scheduled Reduction

4. The outage duration is expected to be:

□ Long (≥ 4 days/outage) □ Medium (1-3 days/outage)
□ Short (< 1 day) □ Very Short (< 12 hours)

5. The modification is expected to:

□ Reduce frequency or duration of an outage
□ Increase frequency or duration of an outage
□ No change in frequency or duration of an outage

6. Modification efficiency:

□ Perfect improvement (100% of problem will be corrected)
□ Medium improvement (50-99% of problem will be corrected)
□ Low improvement (≤ 49% of problem will be corrected)

III. Personnel Safety (to be utilized by Plant/Safety/ALARA Engineers)

A. Industrial Safety

1. Specific location of modification (building, elevation, cubicle, etc.).

____

____

____

2. Which existing activities and department personnel (OPs, Maintenance, I&C, Chemistry, HP, etc.) are affected by this modification?

□ Surveillance (increase or decrease ____ person-hours/year)
□ Preventative Maintenance (increase or decrease ____ person-hours/year)
□ Corrective Maintenance (increase or decrease ____ person-hours/year)

Departments ______________________________

3. Which new activities are created and which departments are affected by this modification?

□ Surveillance (increase or decrease ____ person-hours/year)
□ Preventative Maintenance (increase or decrease ____ person-hours/year)
□ Corrective Maintenance (increase or decrease ____ person-hours/year)

Departments ______________________________

4. Is staging, scaffolding, or crane support required to complete the project?
   □ Yes □ No (If yes, describe height, brief layout, etc.)

   ____

   ____

   ____

   ____

5. Describe known hazards, potential accidents, or random equipment faults that could occur in the near modification vicinity (e.g., acid/caustic, hydrogen, etc.).

   ____

   ____

   ____

   ____

6. Does the <u>potential</u> exist for one or more of these types of personnel injuries to occur (assuming random equipment faults/accidents) for work activities affected by this project? (D = During Construction; A = After Completion)

	D	A		D	A		D	A
□ Slips	□	□	□ Falls (How far? ________)	□	□	□ Impact Injuries	□	□
□ Trips	□	□	□ Heat Stress/Stroke	□	□	□ Eye Injuries	□	□
□ Fatigue	□	□	□ Burns (Severity ____ ___)	□	□	□ Amputation	□	□

   □ Other (describe) ______________________________

B. <u>Radiation Safety</u>

1. Installation man-rem cost:

   What is the estimated man-rem required to complete this job?

   □ 0--Nonrad Job   □ >5 man-rem
   □ <1 man-rem   Estimated total _______ man-rem:
   □ 1-5 man-rem   Basis: ______________________

2. Before/after man-rem cost/savings:

   a. Will this project increase or decrease the man-rem hour requirements in a radiological area? □ Yes □ No   □ Increase □ Decrease

      If yes: <u>Area</u>   <u>Effective Dose Rate</u>   <u>Change in Man-Hours/Yr</u>

   b. Will this project increase or decrease dose rates in any area of the plant?
      □ Yes □ No   □ Increase □ Decrease

   If yes: <u>Area</u>   <u>% Change in Dose Rate</u>   <u>Current Man-Rem/Yr in This Area</u>

IV. Personnel Productivity (to he utilized by designated ARM reviewer)

A. People

Does the proposed change impact: Impact/Direction/Magnitude

1. Personnel workload? □ Yes □ No Increase/Decrease/__________
2. Training requirements? □ Yes □ No Increase/Decrease/__________
3. Individual skill level? □ Yes □ No Increase/Decrease/__________
4. Communications potential? □ Yes □ No Increase/Decrease/__________

B. Tools and Equipment

Does the proposed change impact:

1. Complexity of tools and equipment? □ Yes □ No Increase/Decrease/__________
2. Physical accessibility of equipment? □ Yes □ No Increase/Decrease/__________
3. Maintenance of equipment? □ Yes □ No Increase/Decrease/__________

C. Environment

Does the proposed change impact: Impact/Direction/Magnitude

1. Location of work tasks? □ Yes □ No Increase/Decrease/__________
2. Environmental factors? □ Yes □ No Increase/Decrease/__________
   (Circle or list others: heat, cold, radiation fields, toxic atmospheres, pressure changes, noise levels, ________________________________)
3. Stressors (physical/psychological)? □ Yes □ No Increase/Decrease/__________
4. Surroundings? □ Yes □ No Increase/Decrease/__________

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Attachment 5

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program

List of ISAP Topics

May 1991

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program
List of ISAP Topics

Topic(*) Number	Title
1.01	Elimination of Unnecessary Alarms
1.02	Station Blackout--Installation of Alternate Diesel Generator
1.03	Residual Heat Removal Auto Closure Interlock Removal
1.04	Service Water Erosion/Corrosion
1.05	Main Board Indication of Cold Overpressure Protection System (COPS)
1.06	Intake Structure Modifications--Phase I
1.07	Replacement of Pratt LLRT Butterfly Valves
2.01	Reactor Coolant System Snubber Reduction
2.02	Removal of Gaseous Chlorine Piping, Relocate Hypochlorite Tanks
2.03	Turbine Deck Monorail
2.04	Service Water Pump Cubicle Sump Pump
2.05	New Fuel Handling Crane Access

(*) As previously discussed in Attachment 3, topics numbered 1.XX are initiated in response to an NRC issue (e.g., inspection finding, generic letter, etc.). Topics numbered 2.YY are initiated internally for varied reasons (e.g., improved safety, reduction in personnel exposure, improved productivity, etc.).

1

IMAGE EVALUATION TEST TARGET (MT-3)

1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2 3.6 4.0

150mm

6"

1

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

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Attachment 6

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program

Detailed Topic Evaluations

May 1991

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program
Evaluation of New ISAP Topics

Topic 1.01--Elimination of Unnecessary Alarms

I. Introduction

The presentation of too much information in the form of excessive annunciated indications can be a problem in the control room operation of nuclear power plants. The high number of energized control room annunciators at Millstone Unit No. 3 observed during initial plant startup could adversely impact the control room operator's ability to respond adequately to abnormal or transient conditions.

NNECO has committed to the NRC Staff, in numerous letters, the last two of which dated August 3, 1989[1] and May 22, 1991,[2] to reduce the number of illuminated annunciators during normal plant operation. This project includes the implementation of plant modifications to alarms/annunciators that either delete those considered to be unnecessary or revise logic. The project is divided into three phases. Phases 1, 2, and 3 have already been implemented. Phase 1 resulted in only internal wiring changes to six illuminated windows. Phase 2 was implemented during the second refueling outage. This phase addressed modifications to three windows. The third phase addressed the remainder of the committed illuminated annunciator windows during the third refueling outage.

II. Evaluation

A. Public Safety

Individually, the proposed modifications only provide a small benefit to the operator and will not reduce the core melt frequency by a significant amount.

Overall, operators are faced with a large number of details which must be taken into account when making decisions. The total contribution of these unnecessary alarms could adversely impact the control room operator's ability to respond adequately to abnormal or transient conditions. The reduction in the number of these unnecessary alarms would improve human reliability and is assigned a public safety benefit of $1,000/year based on engineering judgement.

B. Economic Performance

Phase 3 of the proposed modification to the Auxiliary Feedwater (AFW) annunciators will impact a situation where the plant is already unavailable (reactor trip occurs), therefore, its effect on plant performance is negligible. However, by ensuring that the AFW system is operational following a reactor trip, the potential for core damage is decreased. Translating this small possibility of preventing core damage into an availability

increase is nonquantifiable and, would yield an insignificant impact.

Although the implementation of Phase 3 of this issue is expected to give the operator additional time to diagnose problems with the AFW, Turbine Plant Component Cooling Water (TPCCW), Reactor Plant Component Cooling Water (RPCWS), or Containment Recirculation System (RSS) its effect on plant availability is negligible.

C. Personnel Safety

The proposed modifications will not affect personnel safety.

D. Personnel Productivity

The design change includes a revised logic scheme for the H_2 recombiner trouble alarms and the elimination of the control building chiller service water low flow alarm. The personnel productivity benefit of $7,168 is derived from a minimized amount of potential operator confusion which could translate into a reduction in the probability of human error.

III. Conclusion

This project received a low relative ARM value and ranking. However, the regulatory sensitivity of this issue has increased project priority. Accordingly, this project was scheduled in the IIS for implementation and all hardware changes were completed in the 1991 refueling outage.

Topic 1.02--Station Blackout--Installation of Alternate Diesel Generator

I. Introduction

Millstone Unit No. 3 was designed, constructed and licensed prior to the issuance of the Station Blackout (SBO) rule as stated in 10CFR50.63. NNECO's comprehensive response was submitted, reviewed, and approved by NRC Staff. Part of the submittal response involved necessary modifications to install an alternate AC (AAC) power supply to meet the SBO rule requirements.

The objective of this project is to install a new alternate 3 MW diesel generator to provide electrical power to the SBO loads for the eight-hour period until off-site or emergency on-site power can be restored.

The detailed scope of this project involves the following modifications:

1. Install a self-contained 3 MW, air cooled diesel generator near the RSST area.

2. Install 4.16 kV power cable in existing ductline and raceway to connect the alternate diesel generator to the normal 4.16 kV bus 34A.

3. Install 4.16 kV power cable to connect 4.16 kV buses 34A and 34B.

4. Modify 4.16 kV switchgear (3MNS-SWG-A & B) as required to accept new power supplies.

5. Add meters to the main control board and required associated cabling to 4.16 kV switchgear to monitor alternate diesel generator's power output.

II. Evaluation

A. Public Safety

During an SBO, the reactor core could conceivably uncover due to a consequential loss of coolant accident (LOCA) events since there is no power to pumps which are capable of injecting inventory into the core. The potential for loss of coolant events following a station blackout is high since the reactor coolant pump (RCP) seal cooling capability is lost as a result of the SBO. The loss of RCP seal cooling will initially degrade seals and could lead to eventual failure of the seals thereby causing a small LOCA. The alternate diesel generator will power a charging pump needed for seal and charging injection, thereby lowering the risk attributed to the SBO events.

The public safety impact has been derived from the following assumptions:

1) The alternate diesel generator will provide all loads required to perform charging injection to the reactor core; i.e., a charging pump and all its auxiliaries.

2) The failure probability of the alternate diesel generator to start and provide power to the station blackout loads within one hour is 0.01.

3) The success of the alternate diesel generator eliminates the potential for consequential small LOCA (RCP seal LOCA) accidents or mitigates the consequences of small LOCAs until full AC power from offsite or one of the two other diesel generators is restored.

Therefore, the core-melt frequency (CMF) would be lowered by 3.5×10^{-6} per year due to the proposed project. The public risk reduction is estimated to be about 2,030 man-rem over the remaining life of the plant. The total benefit associated with the proposed design change is $66,670/year.

B. Economic Performance

The consequence of a diesel failure has a direct impact on plant operation; however, there are fairly stringent Technical Specification requirements that would affect plant availability. Presently, if one of the existing diesel generators is declared inoperable, a 72-hour limiting condition of operation (LCO) takes

effect calling for a shutdown. If both diesels are inoperable, then there is a 2-hour LCO calling for a shutdown.

With the addition of the new alternate diesel, it is yet unclear what its associated Technical Specification requirements will be. The LCO requirement would likely range from 2 weeks to 6 months for the inoperable alternate diesel. There is a possibility that with the additional diesel in place, there may be some relief on the present Technical Specification requirements for the existing diesels.

Because of this uncertainty in knowing what the actual requirements will be, an assumption was made. It was assumed that the new Technical Specification "inoperability" requirements for the alternate diesel will be the most conservative; a two-week period, or 336 hours.

The addition of the alternate diesel generator will contribute to a very small negative impact on plant availability; however, this is expected to be somewhat less than the calculated 0.24 hrs./year because its "inoperability" Technical Specification requirement is expected to have greater flexibility; 336 hours opposed to a 72-hour LCO requirement. In addition, this small negative impact could potentially be offset by some future relief of the Technical Specifications requirements for the existing diesels. Thus, the net economic performance impact is concluded to be zero.

C. Personnel Safety

The proposed modifications will not affect personnel safety.

D. Personnel Productivity

The increased training and preventive maintenance requirements impact personnel productivity by -$30,720/year.

III. Conclusion

Although this project received a high public safety score, its ARM value and relative ranking were moderated due to an extremely negative personnel productivity score and a high remaining project cost. Accordingly, the modification is scheduled in the IIS for the 1992 refueling outage.

Topic 1.03--Residual Heat Removal Autoclosure Interlock Removal

I. Introduction

During Residual Heat Removal (RHR) operation, if the pressure in the reactor exceeds 750 psig, the RHR system (designed for only 60` psig.) is isolated from the Reactor Coolant System (RCS) by automatic closure of suction valves 8701A and B and 8702A and B in the RHR suction lines. This feature of the RHR suction valves is referred to as the Autoclosure Interlock (ACI).

The industry has experienced a large number of loss of RHR events contributed by the spurious operation of the RHR ACI circuitry. The NRC encourages removal of the RHR ACI feature, if it is determined by plant-specific analysis that no adverse impacts result from the ACI removal.

The proposed project involves the removal of the autoclosure interlock from the RHR system suction valves 3RHS*MV8701A and B and 3RHS*MV8702A and B. In addition, an alarm would be added to each suction valve which would actuate if the valve is open and the pressure is at a high setpoint. Also, the project is consistent with the recommendation of Generic Letter 88-17, "Loss of Decay Heat Removal."

II. Evaluation

A. Public Safety

The removal of the RHR ACI feature impacts the public risk in three different ways: 1) the frequency of interfacing system LOCAs (ISLOCA) or Event V is affected, 2) the unavailability of the RHR system for shutdown cooling is affected, and 3) the mitigation capability of overpressure transients during shutdown is affected.

Westinghouse performed an analysis to investigate the impact of the Interfacing System's LOCA frequency of the RHR ACI removal. Based upon a Millstone Unit No. 3 specific preliminary analysis performed using the Westinghouse methodology, it was found that the Millstone Unit No. 3 Event V frequency reduces from 3.46×10^{-8} per year to 7.54×10^{-10} per year. The Event V frequency reduction, in spite of the RHR ACI feature removal, is attributed to the new alarms to be installed as a part of this project indicating the "OPEN" position of RHR suction line MOVs at high reactor pressure.

Based on a CMF reduction in Event V of 3.38×10^{-8}/year, a CMF reduction of 2.4×10^{-5}/year because of increased RHR reliability, and risk reduction of approximately 79.80 Man-Rem, this project has a public safety impact of $62,364/year.

B. Economic Performance

The removal of the autoclosure interlock on the RHR pump suction valves will increase the RHR system reliability/availability. However, concerning the impact on plant availability, removal of this interlock will not likely extend or reduce plant downtime because the RHR system is backed up by a redundant 100 percent capacity train. Also, it will not increase or decrease the number of plant trips or reductions because ACI failure is not readily detectable during power operation. Therefore, the effect of this issue on plant availability would be negligible.

C. Personnel Safety

The proposed modification will not affect personnel safety.

D. Personnel Productivity

The elimination of the autoclosure interlock eliminates the need for required valve and instrument maintenance, testing and training. Therefore, the benefit to personnel productivity is $21,760/year.

III. Conclusion

This project received the highest ARM value and relative ranking due to a high public safety score, high personnel productivity score, and a small remaining project cost. As such, the modification was scheduled in the IIS and was completed during the 1991 refueling outage.

Topic 1.04--Service Water Erosion/Corrosion

I. Introduction

By letter dated July 18, 1989,(2) the NRC transmitted Generic Letter (GL) 89-13, Service Water System Problems Affecting Safety Related Equipment. NNECO had identified a concern regarding service water erosion/corrosion and began to study the issue prior to GL 89-13. NNECO's response to GL 89-13, dated January 25, 1990,(3) explained that the ISAP would be utilized to address and resolve future programmed enhancements (hardware modifications).

The service water system is one of the major plant support systems. It cools a number of important emergency and normal system heat loads. The service water system is an open cycle system which takes suction from the ultimate heat sink, Long Island Sound, removes heat via heat exchangers from various systems and components that it serves, and discharges the water back to the Sound.

Erosion and corrosion in the service water system piping and components could adversely affect the performance of their intended safety functions. Piping is degraded by corrosion and/or erosion resulting in service water leakage. Some heat exchanger tube leaks can cause safety-related pumps to fail as a result of service water entering their lube oil coolers.

To eliminate service water system piping degradation due to erosion/corrosion, the turbulence in the piping must be reduced. Therefore, the proposed modifications involve changes in the piping geometry. This means generous radii for changes in flow direction. Currently, the service water system elbows were designed with a radius of about 1.5 times the diameter of the pipe. In addition, tees were used to turn the flow. The proposed modification will be to use bent pipe with a radius of five times the pipe diameter. Where this is not possible, the damaged areas could be repaired with more erosion/corrosion resistant coating. In some cases, heat exchangers may be redesigned. The systems affected by these service water pipe repairs include charging pump cooling (CCE), safety-injection pump cooling (CCI), reactor plant component cooling water (RPCCW), and ESF Building ventilation (HVQ).

II. Evaluation

A. Public Safety

In general, the failure probability of piping is much smaller than the failure probability of valves and pumps. The erosion/corrosion issue does increase the probability of piping failure but the system unavailability is still dominated by pump/valve failures. The service water piping redesign and repair could potentially prevent a loss of cooling to safety-related equipment (i.e., charging pumps, safety-injection pumps) due to erosion/corrosion. The proposed project will increase service water reliability slightly. This proposed project has no adverse impact on public safety and is subjectively assigned a score of $500/year based on engineering judgement.

B. Economic Performance

The unit has not experienced forced outages, deratings, or scheduled outages due to service water system erosion/corrosion. However, the 56 hours of critical path time for leak repair during the second refueling outage equates to 14.0 average equivalent hours/Unit-Yr. for the four-year period 1986-1989.

Continued outage work (on or near critical path) is expected until the erosion/corrosion-related leaks are eliminated and steps are taken to prevent recurrence. It has been assumed that the availability loss expected during future operating periods is at least as high as losses experienced during the first four years of operation.

The impact on plant performance of failure to implement this issue is 14.0 hours lost generation per year. Therefore, the benefit of avoiding 14.0 hours of lost full power operation per year equates to an economic benefit of $374,808/year.

C. Personnel Safety

The proposed modification will not affect personnel safety.

D. Personnel Productivity

The number of required service water system piping repairs due to erosion and corrosion damage will significantly decrease as a result of the proposed modifications. Therefore, the overall value of this project on personnel productivity is $76,800/year.

III. Conclusion

This project received a high ARM value and relative ranking due to the benefits derived from economic performance and personnel productivity. Accordingly, this modification has been scheduled in the IIS to be completed during the 1991 and 1992 refueling outages.

Topic 1.05--Main Board Indication of Cold Overpressure Protection System (COPS)

I. Introduction

The purpose of the Cold Overpressure Protection System (COPS) at Millstone Unit No. 3 is to provide pressure protection of the reactor coolant system (RCS) under relatively cold conditions. At these cold conditions, the absence of the pressurizer's steam bubble (water solid condition), along with a sudden increase in pressure (which COPS is designed to prevent), could expose the reactor pressure vessel (RPV) to brittle fracture conditions. COPS uses the power-operated relief valves (PORVs) to relieve excessive pressure to prevent brittle fracture.

The Millstone Unit No. 3 COPS consists of two channels. Each of these channels can initiate a protective action which will cause the two power operated relief valves (PORVs) to open. The proposed project will provide a positive indication of the COPS active status.

During an event which occurred at Millstone Unit No. 3 in January 1988, the RHR letdown path was inadvertently isolated. Since the RHR was isolated, the RHR RVs were not available for the pressure release during the subsequent overpressure transient. Therefore, the COPS was the only system available to relieve pressure. However, COPS failed to operate since the solid state protection system associated with COPS had been disabled. The root cause of this event was a lack of procedural guidance for the arming of the COPS, thus ensuring its operability. This event prompted investigations on how the COPS design might be improved to avoid the recurrence of a similar event.

II. Evaluation

A. Public Safety

The public safety impact has been derived from the following assumptions: 1) upon the occurrence of an overpressure transient during shutdown, should the COPS and manual PORV actuation fail, and if the running charging pump could not be tripped, then a RPV over stress (failure) could result in a core melt, 2) in light of the failure probabilities associated with arming of COPS and the COPS logic failure, the proposed design change reduces the unavailability of COPS by 2×10^{-4}. Therefore, the core melt frequency (CMF) decreases by 1.04×10^{-6}/year. The benefit of the change is equivalent to \$2,600/year. Depending upon the progression of events (successes and failures of systems and operator actions), a core melt resulting from overpressure accidents can lead to different plant damage states. Detailed analyses performed indicate a public risk reduction of 110.60 man-rem. This risk savings is equivalent to \$3,160 per year. Therefore, the total public safety benefit associated with this project is \$5,760/year.

B. Economic Performance

The COPS is enabled when the plant is in Modes 3 (below 350°F), 4, 5, and 6. The system is disabled during power operation, thus, there cannot be an availability impact because a failure opportunity does not exist. The system is designed to be tested during plant operation without affecting output or availability. The proposed modification does not reduce the probability of a cold overpressurization event; however, it would marginally reduce the risk of damage to the RCS by allowing the operators to take corrective actions sooner, thus, mitigating the transient.

Consequently, since the probability of a pressure transient is not affected, lost plant availability (outage extension) due to a technical specification violation should not differ to any measurable degree. Therefore, the proposed modification will not have an economic performance benefit.

C. Personnel Safety

The proposed modification will not affect personnel safety.

D. Personnel Productivity

The proposed modification will have a negative impact on personnel productivity due to surveillance increases. Therefore, the impact on personnel productivity is -$5,120/year.

III. Conclusion

This project received a medium relative ARM value and ranking. This upgrade has been scheduled in the IIS to be completed during the 1994 refueling outage.

Topic 1.06--Intake Structure Modifications--Phase I

I. Introduction

This project will modify and upgrade equipment within the intake structure to lessen the fouling of the traveling screens and the number of turbine trips associated with the intake structure. The originally designed systems provided insufficient marine debris removal capability. Modifications include: trash rack modifications; traveling screen modification; maintenance and replacement programs on equipment affected by corrosion within the intake structure; and improving the general environment in the intake structure. These phase 1 modifications, for the 'A' and 'C' bays, are not expected to eliminate all turbine trips associated with the intake structure; however, they will have a significant effect. Subsequent phase 2 modifications to the 'B' and 'D' bays are expected to continue to reduce the number of turbine trips.

Millstone Unit No. 3 uses water from Long Island Sound to cool exhaust steam exiting the low-pressure turbines and entering the condensers and for service water. Debris is removed from the water before it is

pumped to the condenser or service water system by a trash rack outside the intake structure and a traveling water screen inside the structure. The traveling screen panels remove smaller material that is not contained or removed by the trash racks. As material collects on the screen panels, the differential level increase activates the drive motors, which rotate (lift) the panels up to the spray wash system. The spray wash system water pressure removes the material entrained on the screens and a trough returns the debris to the bay.

During storms, the combination of wind, waves, and tide can deposit large amounts of debris onto the intake which cannot be removed efficiently by the present system. The traveling screens become loaded with material to the point at which the screen wash system only partially cleans the panels. The troughs occasionally get overloaded and clog, causing debris to carry over to the backside of the screen, overloading the backside spray system. If debris gets by the travelling screen system, it can migrate to the pumps and condensers. This can potentially damage the pumps and requires that the condensers be backwashed. As the debris accumulates on the trash rack and travelling screens the increasing level has caused circulating water pump trips with subsequent turbine/reactor trips on reduced condenser vacuum.

II. Evaluation

A. Public Safety

Millstone Unit No. 3 has experienced approximately 1.77 turbine trips per year directly related to the existing system design and equipment located within the intake structure. The turbine trips are the result of high differential pressure across the traveling screens due to seaweed or marine fouling of the screens. Under storm conditions, the existing equipment is incapable of maintaining the travelling screens free of debris.

The proposed modifications should reduce a portion of the turbine trips associated with equipment located within the intake structure. It was assumed that only half of these trips could be eliminated for this analysis, due to general uncertainty and to be conservative. Based upon this, the impacts of this issue were assessed to have an approximate 1.4E-6/yr reduction in the CMF and the public risk impact could possibly be reduced by approximately 220.85 Man-Rem. Therefore, the cumulative public safety benefit due to the CMF reduction and the off-site impacts is $9,810.00/year.

B. Economic Performance

Since commercial operation began, there have been nineteen lost power incidents--eight reactor trips and eleven downpowers--due to high condenser vacuum caused by high debris loading on the trash rack and traveling screens. Equivalent total lost generating time is 1116.3 hours. Due to the unpredictability of the environmental conditions (weather, tide, etc.), it is conservatively estimated that the proposed modifications will be

50 percent effective in reducing related future plant unavailability.

The economic impact of the proposed modifications has been reevaluated based on recent operational impacts. The trash rake replacement and traveling screen modification has an economic performance benefit of $4,131,309/year, assuming the proposed replacement and modification reduces future plant availability losses by 50 percent based on Millstone Unit No. 3 historical experience.

C. Personnel Safety

The proposed modifications provide a minor positive impact on personnel safety by easing the trash rack cleaning process. The personnel safety benefit is $540/year.

D. Personnel Productivity

The proposed modifications provide a benefit due to maintenance improvements. The personnel productivity benefit is $20,480/year.

III. Conclusion

Overall, this project received a high ARM value and relative ranking due to the moderate public safety benefit, high personnel productivity score, and high economic performance benefit. Accordingly, the modifications to replace the 'A' & 'C' bay screens were scheduled in the IIS and were completed during the 1991 refueling outage. Subsequent phase 2 modifications will be similarly evaluated, scheduled, and reported in a subsequent ISAP/IIS submittal.

Topic 1.07--Replacement of Pratt LLRT Butterfly Valves

I. Introduction

Containment isolation valves are designed to isolate piping which penetrates the containment boundary. Failure of these valves to maintain containment integrity could result in containment breech and a radioactive release following an accident within containment. Butterfly valves manufactured by the Henry Pratt Valve Company and used for containment isolation have experienced leakage due to a failure of the valve seat's rubber lining. Those valves which do not meet required Local Leak Rate Test (LLRT) criteria must be repaired. Pratt valves cannot be repaired on site and must be returned to the manufacturer for repair.

Pratt valves are also located in other systems within Millstone Unit No. 3. Pratt valves located in the recirculation spray, Reactor Plant Component Cooling Water (RPCCW), and service water systems are used to isolate equipment for maintenance and testing. If these valves fail to close, maintenance or testing cannot be performed as required. In some instances, the plant may be required to shutdown as a result.

The proposed project evaluates two options. The first involves replacing 34 of the Pratt valves in the service water, RPCCW, recirculation spray, and quench spray systems with butterfly valves from another manufacturer. Most of these valves are used for containment isolation. The second option involves storage of spare Pratt valves on site to replace those that require repair.

II. Evaluation

A. Public Safety

Based on discussions with Unit No. 3 Operations personnel and a review of past valve failure, data from the Nuclear Plant Reliability Data System (NPRDS), the Pratt butterfly valves do not have a significantly higher failure rate than other butterfly valves. Certain Pratt valve failures, linked to the rubber lining of the valve seats, have resulted in some failure to meet the LLRT requirements, which could affect containment integrity. If the proposed project replaced the Pratt valves with other manufacturers' valves which had a lower failure rate, the modification would have a positive impact on safety. But based on the lack of information available on the replacement valves, it is assumed that the Pratt valves and the replacement valves have the same failure probability. Therefore, this proposed modification has a negligible impact on risk.

Storage of additional Pratt valves on site does not affect the safety implications of valve failure. The failure probability of the valves remains the same but the amount of plant downtime and inconvenience to the plant is significantly reduced. With either proposed fix, the public safety risk impact is $0/year.

B. Economic Performance

To date, the cause of the past containment recirculation system motor operated valves (MOVs) Pratt butterfly valve failures during their LLRTs has been identified as entrapped foreign material between the rubber valve seat and butterfly valve. The current failure rate of Pratt MOVs during LLRTs is 0.5 failures/year (two failures in four years of operation). In the future, failures discovered during LLRT valve testing can potentially cause the unit to enter Type A testing and would require 2 weeks of outage time to perform the ILRT. (One week for two consecutive outages or 9 hours/year.) Based on the subjective analysis, the potential plant availability impact for Pratt valve replacement (Option 1) is 102 hours/year which includes 93 hours for maintenance and 9 hours for reducing the LLRT failure rate. Therefore, the modifications provide an economic performance benefit of $2,730,713/year. Option 2, storage of replacements, would provide a substantial economic performance benefit, but an order of magnitude lower than the option 1 replacement.

C. Personnel Safety

As proposed by Option 1, replacement of 34 Pratt Valves will provide a small personnel safety benefit of $257/year. However, Option 2, the storage of spare Pratt valves on site, will not affect personnel safety.

D. Personnel Productivity

Replacing 34 of the Pratt valves with butterfly valves from another manufacturer will increase personnel productivity due to minimized maintenance required by valve seat failures. Therefore, the personnel productivity benefit is $21,760/year.

Storage of spare Pratt valves onsite will not affect personnel productivity

III. Conclusion

Option 1, Pratt Valve Replacement, received a high ARM value and relative ranking due in part to the high economic performance benefit and personnel productivity contribution. As such, this project will be addressed in phases. Phase I involves the procurement and delivery of 7 spare valves. This was scheduled to be accomplished during the 1991 refueling outage. Vendor valve testing, prior to shipment, has extended delivery. Phase II, which involves the replacement of 34 Pratt valves is being considered for subsequent outages. Additional information will be supplied in a future ISAP/IIS Update report.

Topic 2.01--Reactor Coolant System Snubber Reduction

I. Introduction

As a result of the Millstone Unit No. 3 Reactor Coolant System (RCS) snubber reduction feasibility study, the reactor coolant loop was evaluated to achieve a support configuration with the fewest possible snubbers. This change in design basis is made possible by the NRC publishing a final rule, in Federal Register, Volume 51, No. 70, dated April 11, 1986, which modified General Design Criteria 4 to allow the use of leak-before-break (LBB) technology for excluding, from the design basis, the dynamic effects of postulated ruptures in primary coolant loop piping in pressurized water reactors. This project proposes to replace/remove 28 of the existing 44 large bore hydraulic snubbers. Sixteen of these snubbers are candidates for removal and the remaining 12 snubbers are candidates for conversion to rigid struts. In addition, 16 mechanical snubbers are candidates for removal from the 8" reactor coolant bypass line.

The primary loop support snubbers are designed to mitigate the dynamic effects of a pipe rupture and pipe failure due to seismic loads. The NRC Piping Review Committee, established to review NRC requirements related to nuclear power plant piping, concluded that the requirements relating to piping design are in some respects conservative. The committee concluded that the design criteria has resulted in overly stiff piping and that excessive use of snubbers and supports, could

have resulted in less reliable piping systems. The committee recommended applying the LBB criteria, in some cases, instead of the loss of coolant accident (LOCA) criteria used previously. The LBB criteria would permit removal of some pipe restraints and thereby enhance the accessibility and inspectability of piping.

This snubber reduction/replacement project is being proposed largely to reduced personnel radiation exposures associated with snubber surveillance and maintenance. Snubber operational reliability has been found to be somewhat less than expected and may result in increased piping stresses. For improving overall reliability of piping systems, the use of snubbers to meet piping system design requirements should be limited. By applying the LBB criteria, snubber removal and replacement is justified. Replacement of some snubbers with rigid struts results in the same lateral restraint against dynamic motion without the snubber maintenance.

II. Evaluation

A. Public Safety

Recent seismic analysis such as Millstone Unit No. 3's has consistently shown that above ground piping is generally not the dominant contributor to the seismic risk. Past analyses have shown that usually the failures of large tanks, structures, and mechanical/electrical equipment contribute the most to the seismic risks. Therefore, an improvement in the seismic capacity of RCS piping is not expected to increase the overall seismic capacity of the unit. Therefore, this modification is assigned a public safety benefit of $250/year based upon engineering judgement.

B. Economic Performance

A potential area of availability impact is decreased outage duration due to decreased congestion around the steam generators and the reactor coolant pumps, thus, expediting maintenance activities in these areas. However, this portion of the issue lacks extensive data to make such a determination and is, therefore, nonquantifiable. Therefore, the availability impact is assumed negligible.

Another area of potential impact is catastrophic snubber failure (present population) with no spare available, thereby increasing outage duration. This would require shipment off-site and approximately 3 to 4 weeks for repair. However, based upon the results of the snubber reduction program, it is assumed/expected that regulatory relief would be requested based upon a seismic analysis that would have been completed for the affected component. Therefore, negligible plant unavailability is assumed.

Based upon a combination of subjective and objective methodologies, the potential availability impact for implementing of the snubber reduction program issue is negligible.

C. Personnel Safety

The proposed modification provides a minor positive impact on personnel safety by alleviating the need to physically remove the snubbers prior to performing the surveillance. The personnel safety benefit is $500/year.

D. Personnel Productivity

The proposed modification provides a benefit due to reduced occupational exposure and improved surveillance conditions. The personnel productivity benefit is $53,760/year.

III. Conclusion

As of this date, final project definition is still underway. Therefore, for this report the IIS shows this issue as a study to be completed by November 30, 1991. This status will be updated in a future ISAP/IIS update report.

Topic 2.02--Removal of Gaseous Chlorine Piping, Relocate Hypochlorite Tanks

I. Introduction

Millstone Unit No. 3 is a coastal station which uses seawater as a cooling medium and is therefore highly susceptible to various forms of marine biofouling. When individual or groups of organisms attach themselves to intake structures and system piping, a highly undesirable decrease in the overall operating efficiency of the affected systems will occur. Historically, this problem has been controlled by injecting acceptably large dosages of chlorine into the various cooling water systems.

The initial portion of the proposed project involved removing and discarding the existing gaseous chlorine equipment, which was no longer in use. This portion of the project has been completed. The existing sodium hypochlorite system will be upgraded and modified to provide a more reliable chemical addition system.

The modifications/upgrading of the present temporary sodium hypochlorite system to improve its reliability will include:

- o Installation of new chemical proportioning pumps and controls with associated piping modifications.
- o Installation of dikes to control potential sodium hypochlorite spillage.
- o Installation of chlorine monitors at the turbine plant component cooling heat exchanger outlets for monitoring residual chlorine levels.
- o Relocation and repiping of the sodium hypochlorite storage tanks to inside the chlorination room.

II. Evaluation

A. Public Safety

The proposed project will enable the plant to achieve chlorination levels for improved biofouling control of service water. The modifications to the sodium hypochlorite system could potentially prevent the failure of a component (i.e., heat exchanger) due to tube fouling or sulfide induced corrosion. This proposed project is subjectively assigned a small public safety benefit of $500/year.

B. Economic Performance

The proposed permanent sodium hypochlorite system is intended to increase the effectiveness, reliability, and availability of the present chlorination system. The failure of the chlorination system will not directly impact the power generation process, but it will degrade the performance of the systems being supported (which will increase their maintenance and surveillance). Improving the effectiveness, reliability, and availability of the chlorination system will not improve or impact plant availability, but it will reduce maintenance man-hours (increase plant productivity) and reduce the potential safety hazard to plant personnel. Therefore, the primary benefit of this project is to improve the effectiveness, reliability, and availability of the present chlorination system. However, improving the chlorination system's effectiveness, reliability, and availability will not impact plant availability and the modification therefore has a near zero economic performance impact.

C. Personnel Safety

The proposed modification will provide a personnel safety benefit as personnel exposure to caustic materials will be reduced. The associated benefit is $420/year.

D. Personnel Productivity

The proposed modifications will improve plant productivity due to the reduction in maintenance man-hours. The associated benefit is $16,128/year.

III. Conclusion

This project received a moderate ARM value and relative ranking. This modification has been scheduled in the IIS for the 1992 refueling outage.

Topic 2.03--Turbine Deck Monorail

I. Introduction

Experience gained during previous refueling outages at Millstone Unit No. 3 has identified an opportunity to improve the turbine deck work flow efficiency and personnel safety. When a major overhaul is performed on portions of the turbine/generator (work that is typical of refuel outages scheduled for every 18 months), the major components require almost exclusive use of the turbine building cranes to support unit disassembly, component location, component inspection, and final unit reassembly. In addition to the work performed on the turbine/generator, numerous parallel work activities are also under way. Some parallel activities are (but not limited to) steam generator feed pump turbine (SGFPT) work, combined intercept valve (CIV) work, condensate pump work (lower level), truck bay work on the south end of the building, and other equipment accessible by removing floor panels. These parallel activities frequently require use of the turbine building cranes for extended periods. In support of the parallel work activities, extensive crane usage schedules must be developed and implemented. In many instances, scheduling conflicts have arisen due to unforeseen circumstances that may unexpectedly tie up the turbine building cranes for extended periods, resulting in schedule slippage of one or more parallel activities.

Installation of monorail crane systems for the "A" and "B" SGFPT area and the bridge crane on the west side of the turbine deck would result in the following benefits:

- o Provide an improved method to remove SGFPT components while reducing hazards or risks to personnel working on or in the vicinity of the SGFPTs.
- o Minimize the number of lifts in the vicinity of plant structural steel interferences and piping runs, reducing the potential for damage to plant equipment during SGFPT overhaul.
- o Reduce scheduling conflicts and permit more efficient use of the turbine building cranes, and possibly reducing total outage time required for turbine and SGFPT's disassembly, inspection, and reassembly.

II. Evaluation

A. Public Safety

The proposed modification would reduce scheduling conflicts and provide a safe method to remove SGFPT components without necessary hazards or risks to plant personnel. However, the modification has no measurable impact on public safety and therefore, this project is assigned a public safety score of $0/year.

B. Economic Performance

The installation of the proposed turbine deck monorail cranes is an addition to plant hardware. The additional equipment does not affect power generation hardware. The plant states associated with equivalent plant output, power generation equipment degradation, a planned repair and/or modification, and power generation equipment failure are unaffected by this issue. Furthermore, the monorail cranes do not affect plant states associated with the thermal efficiency or capacity of the plant.

The only plant states which the monorail cranes are related to are associated with critical path or refueling outage hardware. It has been recognized that certain work situations on the turbine deck could create a scheduling problem for the crane's work schedules. These problems were estimated to affect the turbine deck work schedule from adding no additional time to approximately 2 days additional work time (using engineering judgment, a one-day affect will be used). This would have no impact on the analysis unless turbine deck work was critical path. Of the remaining refueling outages left in the balance of the life of the unit, 10 percent of the refueling outages could be estimated as having turbine deck equipment being critical path (i.e., 2.1 outages).

Therefore, assuming that use of the proposed monorail would reduce critical path time during certain future refueling outages, the benefit from the implementation of this project is 1.4 hours of full power operation per year, which equates to an economic performance benefit of $37,480/year.

C. Personnel Safety

The proposed modification will provide a personnel safety benefit calculated to be $480/year.

D. Personnel Productivity

The improved accessibility to components requiring maintenance provide for a significant personnel productivity benefit of $24,320/year.

III. Conclusion

This project received a moderate ARM value and relative ranking. This modification has been scheduled in the IIS to be completed by December 31, 1992.

Topic 2.04--Service Water Pump Cubicle Sump Pump

I. Introduction

The service water pump cubicle modification was generated in response to a utility-sponsored concern. The concern is that failure of the

service water sump pump to remove service water pump seal and strainer leakoff could result in flooding of the service water pump cubicle.

The service water pump house (EL. + 14.5 feet) is divided into two cubicles, each separated by a fire, missile proof, and watertight wall. Each cubicle contains two service water pumps, two self-cleaning strainers, and a sump pump. During normal operation, both service water loops shall be operable. In accordance with technical specifications, a 72-hour limiting condition for operation (LCO) will occur when only one service water loop is operable. If the inoperable loop is not restored within 72 hours, the plant will be in hot standby within the next 6 hours and in cold shutdown within the following 30 hours.

The leak tight design of the service water cubicle makes it possible for internal flooding to occur from either pipe rupture/leakage or failure of the sump pump. The proposed conceptual modifications are not designed to prevent flooding due to a service water pipe rupture. The proposed modifications address normal service water pump seal and strainer leakage.

Modifications to the service water sump include drilling a hole (core bore) in the cubicle floor to provide the primary (normal) drainage path for the service water pumps' seal and strainer leakage. In addition, the existing sump pumps will be rebuilt and used as backup during severe weather conditions (sea level greater than +13 feet EL.) Vital power will also be supplied to each sump pump to further reduce the probability of sump cubicle flooding.

II. Evaluation

A. Public Safety

The currently installed sump pump will be replaced by the proposed passive (drainage) system. Therefore, it is estimated that the modification to the SW cubicle sump pump reduces the failure probability of a SW pump train by 4.6×10^{-5}. Based on the above value, the reduction in the core-melt frequency (CMF) due to the proposed design change is calculated at approximately 2.0×10^{-7}/year. The internal flooding event resulting from the sump pump failure is a long-term event which is easily recoverable. Therefore, a relatively low mean man-rem equivalent was assigned to determine the public risk reduction. The risk reduction associated with this project is .21 man-rems. The CMF reduction and the public risk benefits associated with this project are $507/year.

B. Economic Performance

Failure of the sump pump to remove service water pump seal and strainer leakage can be caused by: 1) loss of electrical (off-site) power, or 2) sump pump mechanical failure. With normal service water seal and strainer leakage (2-5 gpm), plant operators have approximately 18 hours from sump pump failure until flooding reaches the vital electrical power buses resulting

in the loss of the service water pumps. The Operations surveillance procedure would most likely identify flooding and implement corrective action (i.e., replacement of sump pump) 10 hours before flooding disables the vital electrical power bus.

With the present configuration, there is a very small, unquantifiable possibility that a sump pump failure could result in plant unavailability. However, for the purposes of this analysis, the overall probability will be considered to be zero based on the above.

Concerning implementation, the proposed modifications may be made during normal plant operation if possible. During the installation of the cubicle drainage hole (core bore), all flow paths into the sump must be substantially reduced or isolated. These flow paths include service water pump seal leakoff and strainer leakage. Although this may temporarily affect plant operation, it is not expected to impact plant availability. Therefore, the implementation of the proposed modification will have zero impact on plant availability.

C. Personnel Safety

The proposed modification provides a minor safety improvement due to the lower probability for electrical shock from water on the cubicle floor. Therefore, the personnel safety benefit is $600/year.

D. Personnel Productivity

The proposed modification causes an increase in productivity due to a decrease in maintenance requirements. Therefore, the impact to personnel productivity is $14,080/year.

III. Conclusion

This project received a reasonably high ARM value and a high relative ranking. As such, the proposed modifications have been scheduled to be complete by the end of 1991.

Topic 2.05--New Fuel Handling Crane Access

I. Introduction

The new fuel handling crane is located on the 52'-4" elevation in the fuel building. It has a ten-ton rating and is used for new fuel receipt and inspection, fuel movement within the area, and equipment movement within the area. This crane accesses the new fuel cask storage area, equipment decontamination area, fuel pool cooling pump area, new fuel inspection area, and the spent fuel pool area.

Normal operation of this crane, via a drop pendant controller, requires no access to the upper crane assembly or the crane boom. However, access is necessary for:

- o Maintenance department's checks and preventive maintenance,
- o Instrument and Control department's calibration of load cells, and
- o Operations personnel to bypass the interlocks that restrict the crane's travel over the spent fuel pool when spent fuel pool crane work is required.

Under this project, a ladder would be fabricated and would be permanently mounted to allow access to the upper crane assembly and boom from the 52'-4" elevation up to the 82'-6" elevation. Temporary scaffolding was installed in late 1987 and has been used for access when necessary.

II. Evaluation

A. Public Safety

The proposed modification will not affect public safety.

B. Economic Performance

The proposed modification will not affect economic performance.

C. Personnel Safety

The proposed modification will increase personnel safety by eliminating the need to erect scaffolding. Therefore, the benefit equates to $2,400/year.

D. Personnel Productivity

The proposed modification will increase personnel productivity due to improvements in accessibility. Therefore, the benefit equates to $1,280/year.

III. Conclusion

Based on the personnel safety and personnel productivity benefits, this project received a moderate ARM value and relative ranking. The modification has been scheduled in the IIS to be completed during the first quarter, 1992.

<u>References</u>:

(1) E. J. Mroczka letter to U.S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 3 Elimination of Unnecessary Annunciator Windows," dated August 3, 1989.

(2) E. J. Mroczka letter to U.S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 3 Elimination of Unnecessary Annunciator Windows," dated May 22, 1991.

(3) J. G. Partlow letter to All Holders of Operating Licenses or Construction Permits for Nuclear Power Plants, Service Water System Problems Affecting Safety-Related Equipment (Generic Letter 89-13), dated July 18, 1989.

(4) E. J. Mroczka letter to W. T. Russell, "Haddam Neck Plant, Millstone Nuclear Power Station, Unit Nos. 1, 2, and 3, Service Water System--Generic Letter (GL) 89-13," dated January 25, 1990.

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Attachment 7

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program

Summary Table of ISAP ARM Scores

May 1991

4/8/91

MILLSTONE UNIT NO. 3 ARM RANKINGS

ISAP #	TITLE	PA #	Overall Rank	Public Safety	Economic Performance	Personnel Safety	Personnel Productivity	Remaining Project cost	Total Value	Rank Value	Public Man-Rem	Occ R/A Man-Rem	Occ Inst Man-Rem	Net Man-Rem
1.03	RHR AUTO CLOSURE INTERLOCK REMOVAL	88-044	1	62,364	0	0	21,760	10,000	99,901	999.01	79.80	0.00	0.00	79.80
1.06	INTAKE STRUCTURE MODIFICATIONS-PHASE 1	89-043	2	9,810	4,131,309	540	20,480	3,000,000	2,917,736	97.26	220.85	0.00	0.00	220.85
1.07	REPLACEMENT OF PRATT LLRT BUTTERFLY VALVES	89-047	3	0	2,730,713	257	21,760	2,076,000	1,923,811	92.67	0.00	9.00	-0.50	8.50
2.04	SERVICE WATER PUMP CUBICLE SUMP PUMP MOD.	89-039	4	507	0	600	14,080	85,000	9,263	10.90	0.21	0.00	0.00	0.21
1.04	SERVICE WATER EROSION/CORROSION	85-127	5	500	374,808	0	76,800	3,000,000	305,311	10.18	0.00	0.00	0.00	0.00
2.03	TURBINE DECK MONORAIL	88-026	6	0	37,480	480	24,320	432,000	40,255	9.32	0.00	0.00	0.00	0.00
1.05	MAIN BOARD INDIC OF COLD OVERPRESS PROT SYS.	89-097	7	5,760	0	0	-5,120	166,000	5,306	3.20	110.60	0.00	0.00	110.60
2.05	NEW FUEL HANDLING CRANE ACCESS	89-044	8	0	0	2,400	1,280	145,000	3,920	2.70	0.00	0.00	0.00	0.00
1.02	STATION BLACKOUT-INSTALL ALTERNATE DIES GEN.	86-233	9	66,670	0	0	-30,720	3,700,000	77,109	2.08	2030.00	0.00	0.00	2030.00
2.02	REMOVE CHLORINE PIPING, RELO HYPOCHLORITE TANK	86-210	10	500	0	420	16,128	500,000	10,138	2.03	0.00	0.00	0.00	0.00
2.01	REACTOR COOLANT SYSTEM SNUBBER REDUCTION	86-244	11	250	0	500	53,760	2,500,000	30,591	1.22	0.00	18.50	-1.00	17.50
1.01	ELIMINATION OF UNNECESSARY ALARMS	86-213	12	1,000	0	0	7,168	491,000	5,352	1.09	35.00	0.00	0.00	35.00

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Attachment 8

Millstone Nuclear Power Station, Unit No. 3
Integrated Safety Assessment Program

Integrated Implementation Schedule

May 1991

NORTHEAST NUCLEAR ENERGY COMPANY
MILLSTONE UNIT NO. 3
INTEGRATED IMPLEMENTATION SCHEDULE

SORT BY EARLY FINISH

TOPIC 1.01 ELIMINATION OF UNNECESSARY ALARMS

TOPIC 1.06 INTAKE STRUCTURE MODS -- PHASE 1

TOPIC 1.07 REPL PRATT LLRT BUTTRFLY VLVS PHASE 1

TOPIC 1.03 RES HT REMVL AUTO CLSR INTERLOCK RMVL

TOPIC 2.01 REACTOR COOLANT SYS SNUBBER REDUCTION

TOPIC 2.04 SERV WATER PUMP CUBICLE SUMP PUMP

TOPIC 2.05 NEW FUEL HANDLING CRANE ACCESS

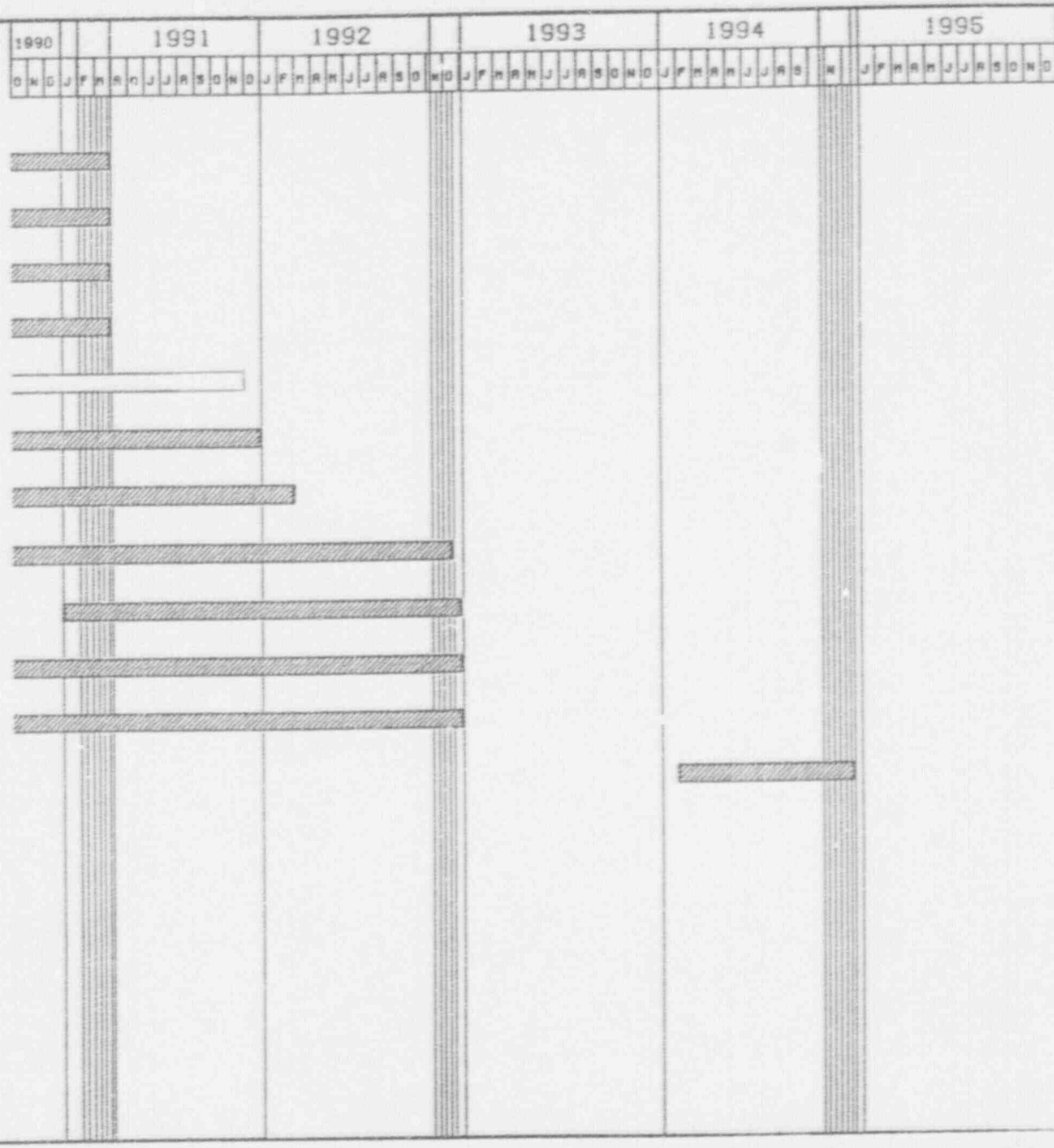
TOPIC 2.03 TURBINE DECK MONORAIL

TOPIC 1.02 STATION BLACKOUT--INST ALTERNATE D/G

TOPIC 1.04 SERVICE WATER EROSION/CORROSION

TOPIC 2.02 REMVL GASEOUS CHLOR PPNG/ RELOC TANKS

TOPIC 1.05 MAIN BOARD INDICATION OF C.O.P.S.



LEGEND
PA TYPES
0 - STUDY
1 - PROJECT

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