May 31, 2000

MEMORANDUM TO: Samuel J. Collins, Director
Office of Nuclear Reactor Regulation

FROM: Ashok C. Thadani, Director **/RA/**
Office of Nuclear Regulatory Research

SUBJECT: USER NEED SUPPORT FOR RISK-INFORMED OVERSIGHT PROCESS

This memorandum responds to your March 17, 2000, request for support in the risk-informed oversight process. For the past year, our staffs have been involved in discussions of your needs and supporting those needs for the risk-informed oversight process. This constant dialog has been very useful and facilitated meeting the critical due dates in your schedules. Keeping the order of the seven major areas, we are responding to your request as delineated in your memorandum. The date RES intends to meet is in parenthesis following each task. These dates have been discussed with your staff. The work, as described below, will not displace any other on-going work supporting NRR. However, it should be noted that currently there are no resources to perform items in parts of 6 and 7. We will continue to work with your staff in completing these items with Mr. Jose Ibarra as the overall point-of-contact.

1. This section responds to NRR needs related to the Significance Determination Process (SDP) internal and external event initiators and mitigation under the Reactor Safety Cornerstones.

    a. In November 1999, RES completed the SDP Inspection Notebooks for the nine pilot plants. In March 2000, RES completed the initial notebooks for the remaining plants in time to support the implementation of the Revised Reactor Oversight Process (RROP). Currently, RES is working with your staff to assist in site visits. The plan is for RES engineers to accompany NRR Senior Reactor Analysts to selected sites and assist in verifying the notebook technical content and obtaining additional information required for construction of SDP Phase II worksheets for special initiators. The effort spent so far on the SDP Inspection Notebooks has been more than originally planned, therefore, the schedules to complete each task will be delayed.

        1) The SDP Inspection Notebooks contain the plant specific SDP Phase II worksheets for internal events during power operations. Each notebook contains the simple functional event trees and the associated SDP phase II worksheets developed from licensee submitted IPE documentation. The notebook is in the format established in the pilot program. (Completed 3/00) Comments from the licensee and NRC staff will be incorporated. (8/00)

2) Each plant specific SDP phase II worksheet will have a corresponding basis document that includes the simple functional event trees, all the success criteria associated with the event trees, any known differences between licensee and SDP modeling, and the sources of information. (9/00)

3) As each Level 1 Standardized Plant Analysis of Risk (SPAR) Model Rev 3 is completed, a review will be conducted by the contractor to identify and resolve major inconsistencies between SDP Notebooks and SPAR. Item 6 provides more schedule detail. In the long term, RES recommends the use of the SPAR models for the inspection notebooks. See Attachment 1.

b. RES has a task order contract with Brookhaven National Laboratory (BNL) to perform a scoping assessment of which plants should have external events incorporated into their SDP phase II worksheets. After completing this assessment, the external phase II worksheets will be produced for those plants designated by NRR based on the results of the scoping assessment. These worksheets will be developed to a similar level of detail as the internal event worksheets. Highest priority will be given to incorporation of fire and flooding event initiators. Currently, the appropriate resources are not available to do this work because the BNL group most qualified to do this assessment is working on the SDP Inspection Notebooks. As the level of effort for the SDP Notebook decreases, BNL will work on the scoping assessment. We will complete the scoping assessment by October and the worksheets by December. (10/00 and 12/00)

The point-of-contact for this area is Mr. Jose Ibarra.

2. This section responds to NRR needs related to risk-based performance indicators (PIs) within the Reactor Safety Cornerstones.

The Risk-based Performance Indicators (RBPIs) will be developed in phases, with a progress report on the first phase of the development to be produced by the July 2000 status report date. Included in this phase of the RBPI development effort will be:

1) Reliability and Availability Indicators for the Mitigating System Cornerstone

2) Indicators for the Containment Barrier Cornerstone

3) Indicators for shutdown and fire events

The point-of-contact for this area is Mr. Hossein Hamzehee.

3. This section responds to NRR needs related to use of the SDP for containment barrier deficiencies, fire protection deficiencies, and any deficiency during shutdown conditions.

a. RES prepared and issued to NRR on February 18, 2000, the draft containment (LERF) SDP technical basis document. We have conducted several meetings

with NRR and our contractor to discuss the work. We have requested NRR and regional SRA comments on the draft document. Once we have received all of

the comments, RES will revise and issue the technical basis document as the final report to NRR. (11/00)

The point-of-contact for this area is Mr. John Ridgely.

b. RES will review and provide feedback on NRR's fire protection SDP. RES will also provide technical review of risk significance determination findings related to fire protection. (4/01)

The point-of-contact for this area is Dr. Nathan Siu.

c. RES has discussed your needs with your staff and have provided the deliverables related to Remote Shutdown Operations involving multiple human actions. (Completed 5/00)

The point-of-contact for this area is Dr. Nathan Siu.

d. RES has discussed your needs with your staff related to developing a frequency range estimate for loss-of-offsite power, loss of RHR, and loss of RCS inventory events. We will provide the information detailed in Attachment 2 by the requested target date. The information will allow NRR to estimate event frequency ranges for loss-of-offsite power, loss of RHR, and loss of RCS inventory. (6/00)

The point-of-contact for this area is Mr. Hossien Hamzehee.

e. In doing task 3(d) above, RES is in-process of providing operating experience data covering the years 1992–1998 that identifies the initiating events that resulted in loss of RHR. In addition, the specific licensee event reports (LERs) utilized to obtain the information will be identified. We believe that identifying the LERs makes it easy to readily obtain additional information on the cause of the events. At the present time, RES does not have the resources needed to provide all the types of information. If additional assistance is still desired, please let us know.

The point-of-contact for this area is Mr. James Houghton.

f. RES will review and provide technical feedback on NRR's shutdown SDP. (5/01).

The point-of-contact for this area is Ms. Mary Drouin.

4. This section responds to NRR needs related to evaluation of licensee corrective action programs (CAPs) during baseline inspections.

RES will develop a method that can be used during a periodic inspection of a licensee's CAP to identify a potentially risk-significant buildup of unresolved deficiencies. RES began in 1999 to explore licensees' CAPs to determine the risk impact in correcting

deficiencies. RES believes that the work completed so far can be expanded to address NRR concerns on risk-significant buildups. (2/01)

The point-of-contact for this area is Mr. Jose Ibarra.

5. This section responds to NRR needs related to monitoring and assessment of human performance deficiencies in the revised reactor oversight process.

RES will evaluate the validity of the assumption that the effects of human performance on plant safety will largely be reflected in the plant performance indicators and inspection findings of RROP. If the assessment identifies adverse effects of human performance on plant safety that are not accounted for through the RROP, RES will characterize the effects, assess their significance, and identify how these effects could be addressed. We will attempt to do this by looking critically at operating experience, other previous human performance analyses conducted by both the NRC and industry, and PRA studies with particular emphasis on ASP. We are developing a statement of work for the Idaho National Engineering and Environmental Laboratory. We will meet your Target Dates. (12/00 and 3/01)

The point-of-contact for this area is Mr. Joel Kramer.

6. This section responds to NRR needs related to computer-based risk analysis models.

RES cannot meet the requested target dates for the Level I internal event and the Level II (LERF) SPAR models with the presently available and budgeted RES resources.

The SPAR model development is being coordinated through the Agency's SPAR Model Users Group (SMUG). We will produce a total of 70 Level I, Rev 3 models over the next three fiscal years. This includes 29 interim models in FY00, 21 interim models in FY01 and 20 interim models in FY02. The interim models include a limited internal QA review. Final models would require plant specific reviews by region and/or plant personnel.

Likewise, we plan on producing Level II (LERF) models beginning in FY01, with completion by the end of FY 2003. To accelerate the production of either of these sets of SPAR models, additional contractor-support funds and RES staff resources that are presently not available would be required.

Development of the low-power/shutdown models is beginning. Presently identified funding and RES resources should be sufficient to permit completion of the models by the requested target date. (12/02)

The point-of-contact for this area is Dr. Patrick O'Reilly.

7. This section responds to NRR needs related to standardization of risk communication within the NRC staff, the public, and other parties that are the recipients of risk information by these processes.

Since the receipt of your User Need Memorandum, a number of activities related to communications have been initiated. A May 1, 2000, memorandum from the EDO requests each Program Office and Region to develop a Communications Plan for important programs supporting each arena of the NRC Strategic Plan. In addition, a Risk-Informed Regulation Implementation Plan is in development and has a Communications Plan as one of its components. It is important that risk communication be addressed in the context of these other programs. We therefore suggest putting on-hold research on risk communication guideline development until we determine how it can be supportive of and integrated within the broader context. Furthermore, there are limited FTE resources and no budgeted funds to perform this work at the present time. (TBD)

The point-of-contact for this area is Mr. Thomas King.

RES will continue to interact with your staff to provide the needed support for the risk-informed oversight process. In addition, RES can assist beyond this scope in the integration of the SDP for reactors and the SDP for containment. This will ensure that variation in containment performance due to different containment designs will be captured in the assessment of a plant's condition.

Attachments: As stated

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Attachment 1

Basis for Future SDP Inspection Notebooks

RES has completed a detailed review of the efforts to produce the significance determination process (SDP) Inspection Notebooks and the efforts to produce the Level 1, Revision 3 standardized plant analysis risk (SPAR) models. Based on the results of this review, we conclude that, with some exceptions, further extensive work on developing the Inspection Notebooks based on the individual plant examinations (IPEs) should be terminated. Instead, we recommend the following:

- The task of correcting the technical information in the current Inspection Notebooks in conjunction with the SDP site visits should be completed.

- The effort underway to identify and incorporate special initiators should proceed as scheduled in order to complete the existing scope of work.

- The enhancements regarding external events should be added to the existing Inspection Notebooks.

- Other than the above three items, future notebook development should be based on the SPAR models.

As more detail has been added to the Inspection Notebooks to address the impact of support systems and special initiators, the event trees have evolved to the point where they are similar to the event trees in the Level 1, Revision 2QA SPAR models. As a result, any further refinement of the notebooks would amount to a duplication between Inspection Notebook and SPAR model developments. We believe that it is a more cost-effective use of resources to pursue only one approach. The Inspection Notebooks are based on the plant IPEs and information obtained from site visits. Although the SPAR models used information from the IPEs, they have also relied on other sources of information regarding plant response and accident mitigation. The implications of this lead to possible differences in results between the Inspection Notebooks and the SPAR models. The goal of a conservative assessment shall continue when the SDP Inspection Notebooks are switched over to SPAR models.

The Inspection Notebooks were a very successful product that was crucial in the implementation of the Reactor Oversight Program. The original purpose of the Inspection Notebooks was to provide a user friendly method for inspectors to link their findings to risk. The notebook was intended to be a useful screening tool for dismissing findings that were non-risk significant and focusing on those which are potentially more risk significant. A key consideration in the notebook development was the ability to produce a complete set covering all operating plants in a timely manner to support the implementation of the Reactor Oversight Program. The Risk Information Matrices (RIMs) based on the IPEs had been developed during the initial stages of development of the Reactor Oversight Program. RIMs were developed to focus inspections, and the SDP was developed to assess inspection findings. The first attempt to develop the notebooks was constructed around the plant-specific RIMs. However, during the Pilot Program, this attempt which consisted mainly of tables, was found to be very unfriendly for

the user. The current notebooks represent the second attempt of using worksheets to produce a useful product for the inspectors. In fact, the reaction to this format by the inspectors was so unfavorable that the plant-specific RIMs have been removed from the notebooks. The worksheets contained in the current Inspection Notebooks have been crucial in laying out information and logically leading the inspectors to connect findings to plant risk. The Inspection Notebooks when switched over to SPAR models will continue to provide the worksheets.

When the effort to develop the SDP Inspection Notebooks began, the Level 1, Revision 2QA SPAR models had been completed. However, the Revision 2QA SPAR models did not typically include support systems, which were crucial to the current Inspection Notebooks. It was recognized that the Revision 3 SPAR models would contain sufficient information for use by the notebook development program. However, the schedule for completion of the Revision 3 models could not support the NRR schedule for implementation of the Reactor Oversight Program. Therefore, we relied on IPE submittals and plant visits to develop the SDP Inspection Notebooks.

Revision 2QA SPAR models represent a complete set of standardized, plant-specific, Level 1 models which have undergone a systematic QA process. Revision 3 SPAR models, which are being developed from the Revision 2QA models, contain many improvements including:

- Event trees which model additional initiating events, including medium- and large-break LOCAs, and the loss of risk-significant support systems (e.g., loss of dc power).

- Explicit modeling of support systems in addition to emergency ac power.

- Modeling of uncertainty and an improved human reliability analysis model.

Technical coordination of user needs for Revision 3 SPAR models is being provided by the SPAR Model Users Group (SMUG). This is an interoffice group of users from NRR, RES, and the regional Senior Reactor Analysts who are familiar with the capabilities of the models and the individual needs of their respective organizations.

The PRA methodology contained in the SPAR models can give more accurate, complete, and consistent assessments than the SDP Inspection Notebooks. The SPAR models do not rely solely on the information contained in the IPEs, which may be obsolete and no longer valid. In addition, the accuracy of the IPEs was not explicitly confirmed by the NRC. Use of the graphical evaluation module (GEM) with the SPAR models can produce all of the inputs to the Inspection Notebooks. GEM can be used easily to identify relevant accident scenarios, given certain equipment configurations (failed, out of services, etc.). Further, GEM can easily produce quantitative results, which can easily be converted to the color coding employed in the SDP process. Conversion of the current GEM module input and output capability to physically resemble the existing SDP Inspection Notebook format will require some modifications to the module, but would be a relatively modest effort. Calculations performed using the GEM interface with the SPAR models are relatively fast and easy. In the future, an electronic version of the SDP Inspection Notebooks could be prepared that would ease updating, availability, and QA.

Attachment 2

Losses of Offsite Power, RHR, and Inventory

PWRS

For PWRs there are four shutdown initiating events.

1. Losses of Offsite Power
2. Losses of RHR due to failure of the system itself or its support systems
3. Losses of RCS inventory that cause loss of RHR (inadvertent RCS losses)
4. Losses of Level Control during midloop operation
   a. operator attempts to reach midloop but overshoots and RHR is lost
   b. operator successfully reaches midloop but cannot maintain level and RHR is lost.

There are four plant operating states (POSs)

1. POS 1 - RHR initiation to cold shutdown (hot shutdown)
2. POS 2 - Cold shutdown operation with the RCS closed such that SG cooling is feasible
3. POS 3 - Cold shutdown and refueling operation with the RCS open such that SG cooling is not feasible and RCS level < twenty-three feet
4. POS 4 - RCS level > twenty-three foot refueling cavity flooded operation. [Note: RCS level > twenty-three feet above the reactor vessel flange corresponds to refueling cavity flooded operation

For the time period between 1992-1998, we will provide:

1. The total number of PWR shutdown hours.
2. For each POS, the number of initiating events in each of the four shutdown categories. [Note: initiating event categories 4a. and 4b. only occur in POS 3. We will attempt to distinguish between the two events, however, if we cannot, the number will reflect the combined total.]
3. The number of PWR refueling outages occurring from 1992-1998.
4. The types and number of 'other' shutdowns occurring from 1992-1998 based on gray book data.

BWRS

For BWRs there are three shutdown initiating events

1. Losses of Offsite Power
2. Losses of RHR due to failure of the system itself or its support systems
3. Losses of RCS inventory that cause loss of RHR (inadvertent RCS losses)

There are four POSs

1. POS 1 - RHR initiation to cold shutdown (hot shutdown)
2. POS 2 - Cold shutdown and refueling operation with the vessel head on.
3. POS 3 - Refueling operation with the head off and level < twenty-three feet
4. POS 4 - RCS level > twenty-three foot refueling cavity flooded

For the time period between 1992-1998, we will provide:

1. The total number of BWR shutdown hours.
2. For each POS, the number of initiating events in each of the three shutdown categories. [Note: If it is not possible to distinguish in the data if the event is occurring in POS 2 or POS 3, the two will be combined.]
3. The number of BWR refueling outages occurring from 1992-1998.
4. The types and number of ‘other’ shutdowns occurring from 1992-1998 based on gray book data.