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NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

March 5, 1979

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In the Matter of
Kansas Gas and Electric Company &
Kansas City Power and Light Company
(Wolf Creek Generating Station, Unit No. 1)
Docket No. 50-482

Gentlemen:

In connection with the Commission's consideration of the Lewis Committee Report (NUREG/CR-0400), the Commission has issued a policy statement on the Reactor Safety Study and its review by the Lewis Committee. The policy statement is enclosed for the information of the parties.

In addition, at the Commission's request, the Staff has conducted a survey of the uses which the Staff has made of WASH-1400. A copy of this survey is also enclosed for the information of the parties.

Copies of the enclosed documents have been furnished separately to all Licensing and Appeal Board Panel Members for their use.

Sincerely,

Stephen H. Lewis

Stephen H. Lewis
Counsel for NRC Staff

Enclosures: As stated

cc: See next page

G

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF PUBLIC AFFAIRS
WASHINGTON, D.C. 20555

No. 79-19
Contact: Frank L. Ingram
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FOR IMMEDIATE RELEASE
(Mailed - January 19, 1979)

NUCLEAR REGULATORY COMMISSION ISSUES POLICY STATEMENT
ON REACTOR SAFETY STUDY AND REVIEW BY LEWIS PANEL

The Nuclear Regulatory Commission today issued a statement of policy concerning its views of the Reactor Safety Study (WASH-1400)* in light of criticisms of the study made by a special review group headed by Dr. Harold Lewis of the University of California at Santa Barbara. The Commission said it accepts the findings of the review group and is taking actions to respond to them. A copy of the Commission's policy statement is attached.

The policy statement noted that while praising the study's general methodology and recognizing its contribution to assessing the risks of nuclear power, the Review Group was critical of the Executive Summary, the procedure followed in producing the final report, and the calculations in the body of the report.

The Review Group also criticized, in some cases severely, various calculational techniques in the study as well as its lack of clarity. The Review Group indicated the Executive Summary is a poor description of the contents of the report and should not be portrayed as such, does not adequately indicate the full extent of the consequences of reactor accidents, and does not sufficiently emphasize the uncertainties involved in the calculation of their probability. The Review Group concluded the Executive Summary has lent itself to misuse in the discussion of reactor risks. The Review Group criticized the peer review process, pointing out that in some cases cogent comments from critics either were not acknowledged or were evaded. The Review Group concluded that the error bounds on accident probabilities were greatly understated.

The Reactor Safety Study was begun under the auspices of the former Atomic Energy Commission and a draft version was circulated for comment in April, 1974. The final report was made public on October 30, 1975 by the Nuclear Regulatory Commission, which assumed the regulatory functions of the former AEC in January, 1975. Criticism of the study has centered on the method of treating peer comments on the draft report as well as on the substance of the final report.

Following letters from Congressman Morris Udall, Chairman of the House Committee on Interior and Insular Affairs expressing misgivings about the Reactor Safety Study, and in particular about the Executive Summary published with the main report, the Commission established a Risk Assessment Review Group in July, 1977. The Commission said it expected that the review group, headed by Dr. Lewis, would assist the Commission in establishing a policy regarding the use of risk assessment in the regulatory process and would clarify the achievements and limitations of the Reactor Safety Study. The Review Group submitted its report on September 7, 1978.

In its policy statement, the Commission said:

(1) It withdraws any explicit or implicit past endorsement of the Executive Summary.

(2) It agrees that the peer review process followed in publishing WASH-1400 was inadequate and that proper peer review is fundamental to making sound technical decisions. The Commission will take whatever corrective action is necessary to assure that effective peer review is an integral feature of the NRC's risk assessment program.

(3) It accepts the Review Group Report's conclusion that absolute values of the risks presented by WASH-1400 should not be used uncritically either in the regulatory process or for public policy purposes and has taken and will continue to take steps to assure that any such use in the past will be corrected as appropriate. In particular, in light of the Review Group's conclusions on accident probabilities, the Commission does not regard as reliable the Reactor Safety Study's numerical estimate of the overall risk of reactor accident.

(4) It has directed that a review be made of Commission correspondence and statements involving WASH-1400 and corrective action as necessary will be taken.

The Commission also said that with respect to the component parts of the Reactor Safety Study, it expects its staff to make use of them as appropriate, that is, where the data base is adequate and analytical techniques permit. The Commission also said that, taking due account of the reservations expressed by the Review Group, it supports the extended use of probabilistic risk assessment in regulatory decision-making. It said that the NRC staff has been provided with additional detailed instructions concerning continued use of risk assessment techniques and results.

#

*WASH-1400 also is known as the "Rasmussen Report."

Attachment

January 18, 1979

NRC STATEMENT ON RISK ASSESSMENT AND THE REACTOR SAFETY STUDY REPORT (WASH-1400) IN LIGHT OF THE RISK ASSESSMENT REVIEW GROUP REPORT

The Risk Assessment Review Group, chartered by the NRC in July, 1977 to "provide advice and information to the Commission on the final report of the Reactor Safety Study, WASH-1400," and related matters, 1/ submitted its report to the Commission on September 7, 1978. The Review Group, chaired by Professor Harold Lewis of the University of California at Santa Barbara, 2/ was formed in response to letters from Congressman Udall, Chairman of the House Committee on Interior and Insular Affairs, expressing misgivings about the Reactor Safety Study (WASH-1400), and in particular about the "Executive Summary" published with the Main Report. It was expected that the Review Group's report would "assist the Commission in establishing policy regarding the use of risk assessment in the regulatory process" and that it would "clarify the achievements and limitations of the Reactor Safety Study."

In August, 1972, the Chairman of the Atomic Energy Commission informed the Chairman of the Joint Committee on Atomic Energy that the Atomic Energy Commission had undertaken an in-house study "to provide a basis for submitting recommendations to the Congress regarding the extension or modification of the Price-Anderson Act." A draft version of the study report was circulated for comment in April, 1974. On October 30, 1975, the Nuclear Regulatory Commission 3/ announced that the final report had been completed. Criticism of the document following release centered on the method of treating peer comments on the draft report as well as on the substance of the report. The NRC press release accompanying publication of WASH-1400 praised the report, describing it as a "realistic assessment..., providing an objective and meaningful estimate of the present risks associated with the operation of present day light water reactors in the United States," gave several comparisons to show that the risk from nuclear power was much less than from other man-made activities, and included a statement that "the final report is a soundly based and impressive work.... Its overall conclusion is that the risk attached to the operation of nuclear power plants is very low compared with other natural and man-made risks." 4/

In view of the importance attached to the Reactor Safety Study, within and outside the Commission, both prospectively and after it was made public, the Commission has reexamined it's views regarding the Study in light of the Review Group's critique.

While praising the study's general methodology and recognizing its contribution to assessing the risks of nuclear power, the Review Group was critical of the Executive Summary, the procedure followed in producing the final report and the calculations in the body of the report.

Among the major failings of the study, the Review Group cited:

The Executive Summary: The Review Group concluded that "the Executive Summary of the RSS is a poor description of the contents of the report, should not be portrayed as such, and has lent itself to misuse in the discussion of reactor risks." The Review Group indicated the Executive Summary does not adequately indicate the full extent of the consequences of reactor accidents and does not sufficiently emphasize the uncertainties involved in the calculations of their probability. As a result, the reader may be left with a misplaced confidence in the validity of the risk estimates and a more favorable impression of reactor risks in comparison with other risks than warranted by the study. 5/

The Peer Review Process: The Review Group Report criticized the RSS staff response, pointing out that in some cases cogent comments from critics either were not acknowledged or were evaded and that, in general, the record of response to valid criticism was weaker than it should have been. The Report points out that the lack of clarity of WASH-1400 itself led to major difficulty in tracing a line of thought through the study and crippled many efforts to accomplish responsible peer reviews.

Accident Probabilities: The Review Group was unable to determine whether the absolute probabilities of accident sequenc in WASH-1400 are high or low, but believes that the error bounds on those estimates are, in general, greatly understated. This, the Report said, is true in part because there is in many cases an inadequate data base, in part because of an inability to quantify common cause failures, and in part because of some questionable methodological and statistical procedures.

The Review Group also criticized, in some cases severely, various of the calculational techniques in the Study as well as its lack of clarity.

The Review Group cited the following as major achievements of the study:

"WASH-1400 was a substantial advance over previous attempts to estimate the risks of the nuclear option.

"WASH-1400 was largely successful in at least three ways; in making the study of reactor safety more rational, in establishing the topology of many accident sequences, and in delineating procedures through which quantitative estimates of the risk can be derived for those sequences for which a data base exists.

"Despite its shortcomings, WASH-1400 provides at this time the most complete single picture of accident probabilities associated with nuclear reactors. The fault-tree/event-tree approach coupled with an adequate data base is the best available tool with which to quantify these probabilities.

"WASH-1400 made clear the importance to reactor safety discussions of accident consequences other than early fatalities."

The Commission accepts these findings and takes the following actions:

Executive Summary: The Commission withdraws any explicit or implicit past endorsement of the Executive Summary.

The Peer Review Process: The Commission agrees that the peer review process followed in publishing WASH-1400 was inadequate and that proper peer review is fundamental to making sound, technical decisions. The Commission will take whatever corrective action is necessary to assure that effective peer review is an integral feature of the NRC's risk assessment program.

Accident Probabilities: The Commission accepts the Review Group Report's conclusion that absolute values of the risks presented by WASH-1400 should not be used uncritically either in the regulatory process or for public policy purposes and has taken and will continue to take steps to assure that any such use in the past will be corrected as appropriate. In particular, in light of the Review Group conclusions on accident probabilities, the Commission does not regard as reliable the Reactor Safety Study's numerical estimate of the overall risk of reactor accident.

Communication with the Congress and the Public: Commission correspondence and statements involving WASH-1400 are being reviewed and corrective action as necessary will be taken.

With respect to the component parts of the Study, the Commission expects the staff to make use of them as appropriate, that is, where the data base is adequate and analytical techniques permit. Taking due account of the reservations expressed in the Review Group Report and in its presentation to the Commission, the Commission supports the extended use of probabilistic risk assessment in regulatory decisionmaking.

The Commission has provided additional detailed instructions to the NRC staff concerning continued use of risk assessment techniques and results in response to specific criticisms raised by the Risk Assessment Review Group.

NOTES

1/ Its charter reads: "The Review Group will provide advice and information to the Commission regarding the final report of the Reactor Safety Study, WASH-1400, and the peer comments on the Study, advice and recommendations on developments in the field of risk assessment methodology and on future courses of action which should be taken to improve this methodology and its application. This advice and information will assist the Commission in establishing policy regarding the use of risk assessment in the regulatory process, in improving the base for the use of such assessments. It will also clarify the achievements and limitations of the Reactor Safety Study."

2/ The other members were Dr. Robert J. Budnitz (Lawrence Berkeley Laboratory, University of California), Dr. Herbert J. C. Kouts (Brookhaven National Laboratory), Dr. Walter Loewenstein (Electric Power Research Institute), Dr. William Rowe (Environmental Protection Agency), Dr. Frank von Hippel (Princeton University) and Dr. Fredrik Zachariasen (California Institute of Technology). Dr. Budnitz is presently on leave from the University of California and is serving (since August 1978) as Deputy Director of the NRC's Office of Nuclear Regulatory Research.

3/ The Nuclear Regulatory Commission was established on January 19, 1975 to carry out the regulatory functions of the Atomic Energy Commission, which was abolished on that date.

4/ The press release at the time of publication said that the report is "the culmination of the most comprehensive risk assessment of nuclear power plants made to date. The objectives of the study were to make a realistic assessment.... The overall conclusion...is that the risks attached to the operation of present day nuclear power plants are very low compared to other natural and man-made risks.... Nuclear power plants are about 10,000 times less likely to produce fatal accidents than man-made non-nuclear activities.... Non-nuclear accidents involving comparable large dollar value damage are about 1,000 times more likely than nuclear power plant accidents.... The chance that a person living in the general vicinity of a nuclear power plant will be fatally injured in a reactor accident is one in five billion per year.... In the event of an unlikely reactor accident with a probability of one in a million per reactor per year, latent health effects except for thyroid nodules would be such a small percentage of the normal incident rates that they would be difficult to detect...."

The NRC Chairman was quoted as saying, "The Commission believes that the Reactor Safety Study Report provides an objective and meaningful estimate of the public risks associated with the operation of present day light water reactors in the United States.... The final report is a soundly based and impressive work.... Its overall conclusion is that the risk attached to the operation of nuclear power plants is very low compared with other natural and man-made risks." The press release went on to say that more than 1800 pages of comments were received from a broad spectrum of people and all were carefully considered in preparing the final report.

5/ Professor Lewis, in reporting to the Commission, said that the Executive Summary was not a summary of the report. He concluded it was written as a public statement that reactors were safe compared to other risks to which the public is exposed and he stated it should not have been attached to the report and described as a part of it.

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December 11, 1978

MEMORANDUM FOR: Lee V. Gossick
Executive Director for Operations

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

SUBJECT: REVIEW OF REGULATORY ACTIONS AND STAFF POSITIONS WHICH RELY ON WASH-1400

As you requested on October 27, 1978, we have surveyed the NRR staff to identify uses of WASH-1400 in the licensing process. We also received and categorized the responses of other Offices. The results of the survey are summarized in Enclosure 1. A synopsis of each of the issues identified by the survey, along with a recommendation for further action, is included in Enclosure 2. Copies of the documents identified by the staff are provided by Enclosure 3.*

To summarize, the staff identified many instances where the Reactor Safety Study was mentioned or discussed, but only a few where the RSS played a substantive role in the licensing process. The responses indicate that the use of the Reactor Safety Study has been increasing since the issuance of the final report on the RSS. This is consistent with the guidance from the Commission (cf., memorandum from S. J. Chilk to L. V. Gossick dated May 13, 1977).

While it is difficult to assure that the survey has identified all documents in which the RSS has been used, we believe it has revealed all substantive licensing actions where the RSS played a major role. We were also provided by Commission Offices copies of Congressional correspondence and prior Commission statements regarding the RSS (memos C. C. Kammerer to S. J. Chilk of October 31, 1978 and K. S. Pedersen to Commissioners of October 11, 1978). As discussed in Enclosure 1, these have also been considered in assessing the results of the staff's survey.

Of all of the material identified, only three were determined to require reconsideration in view of the Risk Assessment Review Group recommendations. They are summarized below.

1. In reviewing the Clinch River application, the staff used the RSS analyses of the time to containment failure for various core melt sequences as an aid in determining what licensing requirements would assure comparability of residual (Class 9) risks between the CRBR and LWRs generally. If the Clinch River review is reactivated or another similar review is requested, this licensing position should be reconsidered.

2. In the report on ATWS, the NRR staff used the RSS estimates of the overall probability of core melt as a benchmark in recommending a quantitative safety objective for ATWS. The staff is reconsidering the degree of reliance on the RSS in light of the Review Group report and expects that the forthcoming supplement to NUREG-0460 will take an approach which is consistent with the Review Group's recommendations.

3. In addressing the concerns of an ACRS consultant relating to d.c. power supply reliability, the staff utilized WASH-1400 to confirm the staff's conclusion that adequate protection of the public health and safety had been provided, and that the evaluation of this generic issue was proceeding at a reasonable pace. The use of WASH-1400 in the staff evaluation of this issue is being reconsidered as a part of the resolution of Task Action Plan A-30 dealing with the adequacy of d.c. power supplies.

The perception of the majority of the staff is that there has been limited use of the RSS in the licensing and regulatory process. However, some of NRC's correspondence and analyses have not clearly set forth the degree of reliance on the results of WASH-1400 relative to a given topic, and most correspondence on the subject does not properly qualify the uncertainties associated with the RSS results. This raises a question of the extent to which the RSS results may have been used to improperly allay concerns about a specific technical issue or otherwise contribute to an imperfect decision-making process. Some have argued (cf., memorandum from D. L. Basdekas to S. J. Chilk of November 28, 1978) that staff reliance on the results of WASH-1400 has contributed to faulty regulatory decisions and faulty representations to the Congress regarding the significance of certain safety issues.

The extent to which the RSS has colored the staff's views on various safety issues is a matter of subjective judgment, which cannot be clearly

determined from the record. However, we view the record as a whole as showing a cautious and prudent application of the RSS by the staff. Its principal application has been to supplement or confirm the main stream of analyses and judgments reached by the staff.

Harold R. Denton

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosures:
As Stated

cc: S. Levine, RES
R. Minogue, SD
W. Dircks, NMSS
J. Davis, IE
N. Haller, MPA
K. Pedersen, PE

ENCLOSURE 1

SUMMARY OF OVERALL RESULTS OF
NRC SURVEYS REGARDING USE
OF WASH-1400 IN THE LICENSING PROCESS

On October 27, 1978, the Executive Director for Operations requested the major program offices to conduct a survey of their staff to identify uses of WASH-1400 in the licensing process. It was also requested that the type of use be described and five broad categories were set forth. These categories ranged from use of numerical risk estimates as given in the RSS to make a specific licensing decision (Category 1) to use of the RSS methodology without relying on the specific numerical estimates in the RSS (Category 5). In addition to the five categories defined there, a sixth category has been added to the list. It contains those actions which did not properly fall into Categories 1 through 5. NRR was requested to coordinate the responses of the survey conducted by the other NRC offices.

In addition to NRR, six other NRC offices (MPA, IE, NMSS, SP, RES, and SD) provided responses to the survey request. A matrix of the number and categorization of issues identified by the responding groups is attached. Of the actions identified by the staff, only two were categorized as Category 1 with the rest falling into the remaining categories. As discussed in the cover memorandum, only three issues were determined to require reconsideration. Thus, it is evident that there were only a few instances in which WASH-1400 was a principal basis relied upon to

make licensing decisions. The preponderance of the actions identified were those instances in which the staff use of WASH-1400 absolute accident risks was restricted to relative comparisons of risks, or the estimates of WASH-1400 were used to illustrate or confirm staff conclusions on the disposition of an issue, or in which the methodology or values of WASH-1400 were independently used or modified to reflect new information.

To some extent, it can be argued that the RSS has shaped or influenced the direction of licensing actions and any reference to the RSS by the NRC implies a use of the RSS. There is a considerable body of correspondence and staff and Commission speeches regarding the RSS and its role in the licensing process (which we would place in the "Other" or Category 6 grouping). However, in most instances, the use of the RSS has been to buttress and add perspective to the normal staff review process.

Listed below are the descriptions of the various categories and the types of applications of the RSS that were identified in this survey.

CATEGORY 1

Definition

Includes those actions in which an absolute value of accident risk as set forth in WASH-1400 was relied upon the licensing process to make a specific licensing decision. Included in this category would be any reliance on an overall probability for core melting or on the probability of a given event sequence leading to core melt. A possible example is the use of the RSS to develop quantitative estimates of health risk from the coal and nuclear fuel cycles.

Example

The two items identified in this category include the example in the definition and the use of the numerical estimates of core melt probability from WASH-1400 to derive proposed safety objectives for ATWS. In both of these instances, either the final report or the planned supplement will include use of WASH-1400 in a manner consistent with the Review Group recommendations.

CATEGORY 2

Definition

Includes those actions in which the absolute values of accident risks of WASH-1400 were used in the licensing process, but when such use was restricted to relative comparisons of risks.

Included in this category would be any reliance on the overall probability of core melting of the RSS to draw comparisons between two design concepts. Possible examples are the use of the RSS to compare an FNP to a land-based plant and the use of the RSS to develop perspectives on overall ATWS risks.

Example

There were 9 items in this category. Typically, items in this category utilize the numerical risk estimates of the RSS (such as a core melt probability of 5×10^{-6} per reactor year) but only in a relative sense.

These assessments did not require that the values used be precise since they were used to compare the relative differences between two or more alternatives or concepts.

CATEGORY 3

Definition

Includes those actions in which the quantitative estimates of fault tree/event tree analyses of WASH-1400 were used in the licensing process to illustrate or confirm staff conclusions on the disposition of a potential safety issue or to aid in selecting the preferred of several alternate regulatory requirements. One possible example is the NUREG-0138, "Treatment of Non-Safety Grade Equipment in Postulated Steam Line Break Evaluations."

Example

Approximately 88 identified issues fit into this category. For these items, WASH-1400 was used to further support or buttress a staff conclusion. WASH-1400 was not the principal basis for the staff action. Rather, the quantitative estimates or the analytical techniques aided the staff in reaching a conclusion. Some of the items contained in NUREG-0138 and NUREG-0153 utilized information from WASH-1400 to help respond to the concerns raised by some individuals that the priority or progress of resolution of certain issues was not proceeding satisfactorily.

Since the values or techniques were only used in a supportive role or to help select a preferred of several alternatives, all but two do not require any reconsideration. One of those two, CRBRP design criteria will be reconsidered if the review is reactivated. The other (reliability of d.c. power supplies) is being reconsidered as a part of generic issue A-30.

CATEGORY 4

Definition

Includes those actions in which values of WASH-1400 were modified by the staff to reflect different data base or experience and were then used in the licensing process.

A possible example is the adjustment of the RSS estimates of scram unreliability in NUREG-0460.

Example

There are 12 items included in this category. Typically, the issues identified used WASH-1400 data as modified or supplemented by the staff to reflect added experience or a different data base before using the more complete information in the licensing process. For example, WASH-1400 data on pipe ruptures was considered along with data obtained by the staff during its review of water hammer events at operating plants.

While the additional failure rate information gathered from operations provided a more complete data base, the decision to proceed with water hammer as a generic issue was based principally on other considerations.

CATEGORY 5

Definition

Includes those actions in which the event tree/fault tree methodology of WASH-1400 were used in the licensing process, but no reliance was made on the specific numerical estimates of WASH-1400.

Example

There were 47 items identified in this category. The items in this category used the evaluation techniques of WASH-1400. An example of this use is in the evaluation of vendor proposed computer protection systems. In thses reviews, the staff performed preliminary reliability assessments using WASH-1400 methodology. These results aided the staff in their deliberations.

Category 6

Definition

This category was added after the responses were received. Issues were placed in this category when they could not be considered to fit into any other categories. Included here are instances when the staff considered using WASH-1400 in the licensing process but dismissed it and staff reviews of WASH-1400 information used by other agencies in their evaluations. Only 8 items were included in this category and any use of WASH-1400 could not be considered to have either significant or direct impact on the licensing process.

	NUMBER OF ISSUES IDENTIFIED*					
GROUP	CAT. 1	CAT. 2	CAT. 3	CAT. 4	CAT. 5	CAT. 6
AIG	0	0	3	0	0	0
DOR	0	0	9	1	1	1
DPM	1	0	4	1	6	2
DSE	1	4	15	1	2	1
DSS	2	6	9	4	16	0
NMSS	0	0	1	0	0	1
IE	0	0	3	0	0	0
RES	0	16	14	4	37	0
SD	0	1	3	1	0	0
MPA	0	0	1	0	1	3
SP	0	0	1	0	0	0
TOTAL	4	27	63	12	63	8

* Note that the total issues identified above is larger than the number in which brief synopses are provided. This occurred because more than one group reported the same issue and some issues were recategorized to more accurately reflect the type of use of the information.

ENCLOSURE 2

SYNOPSIS OF ISSUES

Synopsis of Category 1 Issues

1. Synopsis: Using the results of WASH-1400, regarding the probability of core melt, the staff recommended in NUREG-0460, that the safety objective for ATWS events be changed from 10^{-7}/RY to 10^{-6}/RY. The staff further recommended that systems to be used to mitigate ATWS events be safety grade or that they could be shown to be reliable using RSS estimates or an updated data base. Other portions of the ATWS study where WASH-1400 is addressed fall into Categories 2, 3 and 4.

   We recommend that these actions be reconsidered and the staff is reconsidering the degree of reliance on the RSS in light of the Review Group report. The forthcoming supplement to NUREG-0460 will take an approach which is consistent with the Review Group's recommendations.

2. Synposis: Health Effects Attributable to Coal and Nuclear Fuel Cycle Alternatives, Draft NUREG-0332 includes references to WASH-1400 data. Somatic health effects have been considered in numerous forms including hearings and impact statements. Although the format of the documents involved has varied slightly, the method of incorporating WASH-1400 has been the same as in NUREG-0332 (draft). No reconsideration of previous licensing actions appears necessary. The final version of NUREG-0332 should include a range of mortality values for the uranium fuel cycle that includes a consideration of a broader range of accident risk estimates.

Synopsis of Category 2 Issues

1. Synopsis: The Safety Evaluation Report for Offshore Power Systems Floating Nuclear Power Plants 1 through 8, NUREG-0054, issued October 8, 1976, referred in its Appendix C to the results of the WASH-1400 study. The WASH-1400 data were used in a comparative sense, and no firm reliance appears to have been placed on the data.

2. Synopsis: The "Estimation of Safeguard-Related Risk Associated with Continued Operation of Existing SNM Processing Facilities" by J. H. Conran in late 1976 and other related earlier documents, compared safeguards-related risk to safety-related risk (as given in WASH-1400), in an attempt to show that NRC safeguards approach should be more conservative.

3. Synposis: Liquid Pathway Generic Study, NUREG-0440, February 1978 and Offshore Power Systems, DES, Part III, NUREG-0127 (Revision 1) uses WASH-1400 methods and numerical values to compare risks of a floating nuclear plant tc land-based plants.

4. Synopsis: Letter to G. Paulson, Assistant Commissioner for Science, Department of Enviromental Protection, State of New Jersey, and minutes of a meeting in New Jersey on March 21, 1977, re: Liquid Pathway Study uses WASH-1400 values to compare risks a floating nuclear plant to land-based plants.

5. Synopsis: Commissioner Action Paper, SECY 78-137, March 7, 1978, Assessments of Relative Differences in Class 9 Accident Risks provides an evaluation of alternatives to sites with high population densities. WASH-1400 consequence

models were used to perform analyses of the differences between the Perryman site and other alternative sites from the standpoint of accident risks.

5. Synopsis: The letter to W. D. Rowe (EPA) dated November 18, 1976, re: nuclear accident risks states that the Reactor Safety Study indicates that the approach to safety as set forth in the Commission's regulations has been successful and that the safety and environmental risks from accidents are lower than the risks from most other natural and man-caused events. This language is patterned after the 1974 Interim General Statement of Policy.

7. Synopsis: Letter from S. Levine to G. Paulson, New Jersey Department of Environmental Protection dated November 9, 1976, regarding an investigation of the probability of hyoptehtical catastrophic accidents in the Oyster Creek Nuclear Power Plant. The use of certain results in the Reactor Safety Study by the author of the Oyster Creek study is questioned in this letter. The critique includes a discussion of how the results in the Reactor Safety Study were generated. In addition, the extrapolation of failure probabilities over a 30-year time period is discussed and compared to the 5-year time period extrapolation in the Reactor Safety Study.

8. Synopsis: Memo from Buhl to Vollmer dated June 6, 1978, provides comments on GSA's DES regarding disposal of Charlestown site. WASH-1400 material used in the DES was discussed and risks described in the DSS were evaluated in the context comparison of overall risk.

9. Synopsis: A June 20, 1977, letter from S. Levine to G. Paulson, New Jersey Department of Environmental Protection, transmitted our comments on a draft report titled, "An Investigation of Probability of Serious Accidents in the Oyster Creek Nuclear Power Plant". The report used failure probabilities from WASH-1400.

Synopsis of Category 3 Issues

1. Synopsis: Testimony presented at the Beaver Valley, Unit No. 1 hearing used a figure of 1×10^{-4} as the base value for probability of pipe rupture leading to a LOCA. A table on p. 15 of the testimony provides ranges of failure rates from various sources.

2. Synopsis: In the CRBRP FES (NUREG-0139, Section 7.1.2) the staff compared a number of selected CRBRP accident sequences with the results of similar sequences analyzed in WASH-1400 in order to provide an additional basis for gaining perspective on risks of very severe accidents in CRBRP.

3. Synopsis: In addition to their deterministic evaluation of the reliability of the control and shutdown system for CRBRP, the staff utilized WASH-1400 data and analyses of

3. Synopsis: Certain Westinghouse Topical Reports rely upon absolute values of probability of accident events as set forth in WASH-1400. These reports currently are under staff review. Certain of these reports (WCAP-8966, WCAP-8976 and WCAP-9213) are referenced in RESAR-414, and the remainder are expected to be referenced in other applications.

4. Synopsis: Risk assessment has been indirectly considered in the Mark I Short Term Pool Dynamic Program (NUREG-0408). The conclusion of the Short Term Program (STP) was that, based on the demonstration of a minimum safety factor of two against failure, the Mark I plants could continue to operate during an interim period of about two years while a methodical and comprehensive Long Term Program is conducted. This conclusion was based on the use of most probable loads for the postulated LOCA and without an evaluation of Safety Relief Valve loads. This approach was found acceptable on the basis of the low probability of a LOCA during the nominal two years needed to complete the Long Term Program. Consideration was also given to the low probability of a LOCA in establishing the Mark I technical specification related to ΔP operation which imposes a positive pressure in the drywell relative to the wetwell so that in the event of a LOCA the pool dynamic loads are reduced.

The conclusions of the Mark I STP are only valid for Mark I plants under ΔP operating conditions. Plants are allowed to operate in a non-ΔP mode for the limited periods specified in the Technical Specifications based on the expected low probability of a LOCA during this time limited period.

5. Synopsis: In discussing the interpretation of General Design Criterion 19, we noted in NUREG-0138 that the analysis of the Browns Ferry fire in the Reactor Safety Study (WASH-1400) supports the staff position that for an event in the control room to lead to serious consequences it would need to involve damage of redundant equipment in the control room (or anywhere else) in such a way that operations at the secondary control stations could not accomplish long-term cooling of the reactor. The staff concluded that a serious accident resulting from damage to the control room is of sufficiently low probability as not to warrant revision of the current design basis. The fire damage experience at Browns Ferry involving (among other things) the loss of control of a number of systems helps to verify the many redundant means are available to resourceful reactor operators to maintain a reactor in safe condition.

6. Synopsis: The staff practice of not requiring that a passive mechanical valve failure be considered as a single failure following a postulated design basis accident is based on our judgment that such failures have an acceptably low likelihood of occurrence during both the injection (short-term) and recirculation (long-term) phases of a loss-of-coolant accident. Further, analyses of ECCS performance in WASH-1400 indicate that passive mechanical failures of valves were unimportant contributors to ECCS unavailability during both the injection and recirculation modes of operation. Thus the staff does not consider that changes in safety criteria are warranted at this time but studies will seek to compile a more rigorous data base on passive valve failures.

7. Synopsis: An Information Report on the Single Failure Criterion (SECY-77-439) was sent to the Commissioners on August 17, 1977. This report describes current practice on application of the single failure criterion to LWR electrical and fluid system It draws upon WASH-1400, in part, to support the conclusion that the single failure criterion, as it is currently ap-

plied, leads to a generally acceptable level of hardware redundancy in most systems important to safety. It also points out that methods such as those used in WASH-1400 will gradually come into increasing use as a supplement to the Single Failure Criterion.

8. Synopsis: In considering loss of offsite power subsequent to normal safety injection reset following a LOCA, we stated in NUREG-0138 that the analyses in the Reactor Safety Study, WASH-1400, indicate the likelihood of a LOCA to be about one change in 1000, per reactor year. This was combined with the probability of the loss of offsite power in a one-hour period following a LOCA (about one chance in 50,000) to obtain a combined probability of this sequence of events which was very low.

On the basis of our review of this issue as redefined in NUREG-0138, the Office of Inspection and Enforcement was to review the emergency diesel loading for operating PWR's to assure that all safe shutdown loads (which includes cooling to the diesel generator) are automatically picked

up following an operator action to reset SIS. I&E inspectors also were to examine emergency procedures to be followed in the event of a LOCA to assure that these procedures do not permit SIS reset by operator action earlier than 10 minutes following the accident signal, unless it can be shown that such action is required in the interests of safety. However, the staff concluded that there is no basis for changes to any operating licenses or for changes of the current staff priority in considering this issue.

9. Synopsis: On July 15,.1977, it was stated to the ACRS regarding DC power reliability that, "...a conservative probabilistic assessment of the likelihood of occurrence of Mr. Epler's postulated scenario which is the basis for the concern regarding DC system reliability has been performed."

"The probability for occurrence of unacceptable consequences, i.e., core melt, as a result of this postulated sequence is 5×10^{-9}. A comparison with the WASH-1400 core melt prediction of 5×10^{-5} indicates that the contribution to core melt of this particular sequence is a fraction of

one percent. Furthermore, this would not change significantly even if it were assumed that there would not be any capability for manual action to restore core cooling; i.e., if this number were one instead of 5×10^{-1}.

A similar conservative assessment has been made for the postulated sequence initiated by simultaneous loss of both redundant DC divisions and predicts a core melt probability of $<5 \times 10^{-7}$. Comparison with the WASH-1400 prediction again shows that the contribution to core melt of the common mode sequence is negligible.

In the staff's judgment, on the basis of the probabilistic assessments cited, core melt resulting from the simultaneous and independent failure of two redundant DC power divisions is so unlikely as to be incredible; and core melt resulting from common mode failure of these systems is very low in likelihood. We conclude, therefore, that adequate protection of the public health presently exists. However, additional technical studies over the next year should and will be performed to add confidence to this judgment." This issue should be reconsidered in association with the completion of Task Action Plan A-30, including a recheck of the anlaysis for use of "the square root method."

10. Synopsis: As noted in NUREG-0138, in the event of a steam line break inside containment, it is necessary to isolate the main feedwater to the steam generator associated with the failed line to preclude overpressurizing the containment and to limit the reactivity transient. If the single active f- `ıre postulated for this accident is the failure of the appropriate safety grade main feedwater isolation valve to function, then credit is taken for closing the non-safety grade main feedwater control valve. Reliance on this non-safety grade valve in the postulated accident evaluation is permitted based on the reliability of these valves.

The staff believes that it is acceptable to rely on the non-safety grade main feedwater control valve as a backup because its design and performance is compatible with the accident condition for which it is called upon to function. The staff position is that utilization of the main feedwater control valve as a backup to a single failure in safety grade components adequately protects the health and safety of the public.

This position was taken in the Safety Evaluation Reports for the Erie, Sundesert and San Onofre (2&3) plants.

11. Synopsis: In a document transmitted to the ACRS in February 22, 1975, regarding grid availability, the staff stated:

"The data base used in the analysis is that provided in WASH-1400. The symbology, WASH-1400 numbers with specific references, sample calculations and tabulated results are attached. The conclusions reached is that the improvement in unreliability of offsite power the emergency buses provided by a second immediate access circuit is not significant. This is true even if the unreliability of the grid, which is the governing factor, were reduced by a factor of 10." This need not be reconsidered other than a recheck of the analysis four use of "the square root method."

12. Synopsis: The Branch input to the proposed response to Congressman Patterson's letter of April 2, 1976 re: Postulated Accidents and the Greene County case indicates that Class 9 accidents have been extensively studied and evaluated on a generic basis in WASH-1400.

13. Synopsis: A letter to Ms. Phyllis Taber dated May 20, 1976 regarding the safety of nuclear power plants discusses relative occurrences and consequences of non-nuclear and nuclear accidents in the Main Report of the Reactor Safety Study.

14. Synopsis: The letter to Lash and Cotton, NRDC, dated October 4, 1976 relating to proposed generic evaluation of risk acceptability quotes former Chairman Anders on the overall assessment of the Reactor Safety Study.

15. Synopsis: The Supplement No. 2 to the Staff Safety Evaluation Report on the OPS case, re: accident evaluations states that WASH-1400 results confirm that accident risks are roughly proportional to population density.

16. Synopsis: Development of paper on Current Accident Evaluation. Practices, dated October 3, 1977. This draft proposes an interim positon that no changes in the safety or environmental regulations pertaining to nuclear power plants is warranted until a detailed evaluation is made of the draft study. WASH-1400 statements are used in a confirmatory manner.

17. Synopsis: Section 7.1 of several DES/FES documents contain similar language relating how WASH-1400 will be used in licensing. Examples provided include Erie, Allens Creek, Yellow Creek, Arkansas Nuclear One, Unit No. 2, Hatch 2, Zimmer and Montague.

The Erie document discusses the Reactor Safety Study and states that the results of the study will be assessed within the Regulatory process on generic or specific bases as may be warranted.

18. Synopsis: Responses to comments on the Allens Creek DES includes the text from the "Introduction and Results" section of the Summary Report of WASH-1400. The Marble Hill response to comments in the DES concludes that the staff's analysis of accidents did not rely on the Rasmussen report as a basis of its evaluations and conclusions.

19. Synopsis: In the Three Mile Island 2 Hearing, staff witness responses to cross examination in transcript, re: Aircraft crash hazards made various references to WASH-1400 during testimony.

20. Synopsis: In external hazards discussions, re San Onofre station in a memo dated October 31. 1978, the probability of a propane explosion was discussed relative to the probability of a LOCA in WASH-1400.

21. Synopsis: Note to J. Lafluer commenting on some EPA studies, dated May 28, 1976. EPA study used data from WASH-1400; NRC was asked to comment on EPA work.

22. Synopsis: Letter to W. D. Rowe (EPA, dated April 5, 1977) regarding staff's intent to extend the WASH-1400 methodology to more likely events. This letter states that the NRC intends to extend the detailed assessments reported in WASH-1400 to more likely events (Class 3-8 accidents).

23. Synopsis: Letter to John E. Ward (AIF) dated September 1, 1978 re: SECY 78-137 and the staff's intended use of Class 9 accident considerations. The letter states that we believe that the Reactor Safety Study consequence model can provide useful insights into a few situations but we are aware of the need to be cautious in the direct application of any such analyses.

24. Synopsis: Testimony of C. Vernon Hodge and Donald J. Kasum related to radioactivity released as a result of sabotage during shipment of radioactive material, Sterling and Pilgrim hearings. The testimony indicates that no credit is given for protection afforded by buildings or for evacuation of the endangered area. WASH-1400 is referenced to indicate that there actually would be a range of mitigating factors.

25. Synopsis: Response (June 1, 1977) to Congressman Moorhead discusses WASH-1400 to show that risk of accident in excess of $560 million is extremely remote.

Recommendation: No further action is necessary.

26. Synopsis: Response (June 12, 1975) to Murphy, JCAE references draft of WASH-1400 in discussion of how small risks from reactors are in evaluating if $560 million is enough of a liability limit.

27. Synopsis: The NRC response (June 2, 1978) to Congressman Hamilton's constituent's letter on nuclear industry subsidies by insuring utilities provide an estimate of annual loss based on WASH-1400 consequences.

28. Synopsis: Page A-2/6 of Revision 1 to Task Action Plan A-2, Asymmetric Blowdown Loads On Reactor Primary Coolant System, cites pipe failure probability estimates from WASH-1400. This information was used to support the staff's engineering judgment for continued operation of the affected plants. In the November 17, 1978 memorandum from Stephen Hanauer, it was recommended that the staff reassess the short-term interim acceptance criteria. However, since the information was used only to support the staff's engineering judgment, NRR believes no reconsideration is necessary.

29. Synopsis: The Safety Evaluation Reports on steam generator operation for Surry Unit No. 1 dated February 8, 1977, Turkey Point, Unit No. 4 dated February 8, 1977, and Surry, Unit No. 2 dated April 1, 1977 used pipe failure probability estimates from WASH-1400. This information was used to support the staff's engineering judgment for continued short-term operation. These three reactors which were experiencing steam generator tube failures were granted continued operation for 60 days.

30. Synopsis: For the extension of the ECCS exemption for Dresden, Unit No. 1, the staff constructed simplified fault trees of selected ECCS equipment and derived numerical probability estimates using failure rates from WASH-1400. The exemption from 10 CFR 50.46 was extended from December 31, 1977 to October 31, 1978. The results of the probability logic were not used in the December 29, 1977 SER. The information was used to support the staff's engineering judgment.

In an October 28, 1977 note to I. Wall, Mr. Taylor sent the results of some probabilistic assessments pertaining to an ECCS single failure exemption for Dresden 1. This was done in response to a request from DOR.

31. Synopsis: The Conclusion section of all Fire Protection Safety Evaluation Reports such as Amendment 60 to Hatch 1 operating license contains a quote from the review group report on te the fire at Browns Ferry (NUREG-0050). The quote is in part, "the study (WASH-1400) concludes that the potential for a significant release of radioactivity from such a fire about 20% of the calculated from all other causes analyzed." This quote has been part of the staff's bases for allowing continued operation of the facilities until implementation of facility modifications.

This statement has been used only to support the staff's overall technical judgment. However, an additional paragraph is being added to the SERs to further clarify the staff's bases for allowing continued operation.

32. Synopsis: In the May 9, 1978 RSB input to the Safety Evaluation for the Haddam Neck Overpressure Protection System, the staff tentatively accepted the results of a quantitative fault tree analysis. This analysis was used as a portion of the supporting basis for omitting as a design base transient inadvertent water injection into the primary system through the high pressure safety injection pump (HPSIP). The fault-tree was constructed primarily of possible operator errors that may combine to cause the event. Failure probabilities were taken from WASH-1400.

33. Synopsis: The February 13, 1976 Safety Evaluation for Vermont Yankee authorized continued operation for 30 days until hold-down devices were installed on the torus. The licensee presented as supporting information pipe failure probabilities from WASH-1400. The staff, with more conservative failure estimates, effectively endorsed probability values as supporting information to the staff judgment in granting continued operation. Other factors affecting staff judgment were the ΔP mode of operation, recent inservice inspections of affecting piping, and short period of time (30 days).

34. Synopsis: RSB's October 18, 1977 Safety Evaluation granted a one cycle exemption from the Appendix K single failure criteria applied to the Big Rock Point Nozzle Spray System (NSS). The exemption request was made since the licensee could not substantiate the ability of the Ring Spray System alone to provide adequate core cooling in light of recent test data. The staff evaluated the probability of a non-refloodable LOCA and the failure of the NSS, and the probability of a LOCA in the NSS (refloodable LOCA) and the failure of the feed-

water system using the WASH-1400 fault tree techniques. The staff's recommendation that the one cycle exemption be granted was not based on these probability assessments alone. Several other factors related to the BRP ECCS performance and reliability were considered by the staff, and our conclusions reflect an integrated assessment.

35. Synopsis: The April 1, 1977 Safety Evaluation granted a six month exemption from the ECCS single failure criteria to San Onofre. Component failure rate data from WASH-1400 were used as a portion of the supporting bases for granting the exemption.

36. Synopsis: Pages A-12/3,4 of Revision 1 to Task Action Plan A-12, Fracture Toughness and Potential for Lamellar Tearing of Steam Generator and Reactor Coolant Pump Supports, cites pipe failure probability estimates from WASH-1400. This information was used to support the staff's engineering judgment for continued plant operation.

37. Synopsis: To achieve a level of safety for CRBRP comparable to that for LWRs as far as residual risks associated with core melt accidents, the staff utilized WASH-1400 analyses of the times to containment failure to aid in establishing CRBRP containment integrity requirements. If the CRBRP review is reactivated, this decision should be reevaluated. In light of the current inactive status of the project, no further action on reconsideration is recommended at this time.

38. Synopsis: Reference to WASH-1400 was made by the licensee in providing the justification for not removing the catwalks from the Nine Mile Point, Unit No. 1 containment torus for a period of five months. To the best of our recollection, the licensee's position was accepted as the basis for continued operation. However, the catwalks have since been removed.

39. Synopsis: WASH-1400 is occasionally used to support reviews of events considered for reporting as abnormal occurrence.

40. Synopsis: In periodic updating of the IE reactor inspection procedures, a cross-check has been made to determine that WASH-1400 high risk event related procedures and equipment receive appropriate inspection attention. Although the specific values stated in WASH-1400 were used in this evaluation, they were used to make subjective comparisons and to confirm previous conclusions.

41. Synopsis: IE is studying ways of using risk analysis to improve the inspection program to make resource allocations and to categorize risk related procedures with emphasis on human factors.

42. Synopsis: Some accident sequences taken from WASH-1400 were made the basis for scenarios in developing procedures for the Incident Response Center. This use is marginal in relation to the significant question being raised, but it is included here to assure completeness.

43. Synopsis: While none of the results or models of WASH-1400 were used in licensing reviews, the consequence model computer code (CRAC) has been used by NMSS in NUREG-0194, a special study of transportation sabotage, and some data from WASH-1400 has been used in generic environmental statements on transportation of radioactive materials (NUREG-0170 and SAND 77-1927). However, no new regulatory actions or changes to rules have resulted from these efforts. Thus, no regulatory actions or staff positions have been affected by WASH-1400 material.

44. Synopsis: In a November 11, 1976 letter from W. J. Dircks to Hon. L. M. Hamilton regarding decontamination processes, reference to the probability and consequences of a core melt as stated in WASH-1400 was made. Since no licensing action was taken no reconsideration is necessary. However, uncertainties should have been presented.

45. Synopsis: Memo from I. B. Wall to R. DeFayette dated August 23, 1976, Subject: Draft Responses for California State Energy Resources Conservation and Development Commission. This memo uses results from the Reactor Safety Study to illustrate the distinction between the design basis accident used for preparation of emergency plans and the Reactor Safety Study. In addition, further clarification was provided regarding evacuation and relocation as used in the Reactor Safety Study.

46. Synopsis: Memo from I. B. Wall to R. W. Houston, dated September 14, 1976, Subject: Probability of 10 CFR 100 Doses. This memo transmits a copy of the memo from I. B. Wall to R. DeFayette dated August 23, 1976. This latter memo is covered in item 4, above.

47. Synopsis: Memo from S. Levine to R. G. Ryan, dated October 7, 1976, subject: Comments on EPA Draft Publication Concerning the Technical Bases for Dose Projection Methods to be Used as a Basis for Protective Actions for Nuclear Incidents. The Comments in the memo use results of the Reactor Safety Study to illustrate points made in the review.

48. Synopsis: Letter from S. Levine to H. B. White, Sacramento County, California, dated June 30, 1976. This letter provides some clarifying information regarding WASH-1400 in terms of establishing an appropriate basis on which to formulate emergency plans.

49. Synopsis: Memo from S. Levine to B. Rusche dated August 9, 1976, Subject: Review of Draft Liquid Pathway Generic Study. This memo uses WASH-1400 results to support comments on the draft liquid pathway generic study.

50. Synopsis: A study performed by Battelle, Columbus for RES on the effects of containment venting on LWR meltdown accident risks compared WASH-1400 results with other results calculated with various containment venting schemes.

51. Synopsis: A Sandia study for research on the value-impact assessment of alternate containment concepts used the methodology of WASH-1400 to determine the potential risk reduction from various containment designs.

52. Synopsis: Memos from Buhl to Stolz dated September 8, 1978, and November 6, 1978, provide a reassessment of the Diablo Canyon analysis of the risk to the public from a seismic event in light of the comments of the Lewis Committee. Methodology and absolute values of risk from WASH-1400 were compared to the applicant's recommendations.

53. Synopsis: Task Action Plant A-37, "Turbine Missiles" (Revision 1) in Section 3, "Basis for Continued Plant Operation and Licensing Pending Completion of Task," states:

"The basis for allowing continued operation of the existing LWRs, pending completion of this task is the low probability of unacceptable damage to an essential system by turbine missiles. The Reactor Safety Study (WASH-1400) assessed the turbine missiles accident risk and concluded that LWR designs have a considerable degree of protection provided by plant design and layout such that the public risk associated with large turbine missiles is insignificant compared to risks from other accident causes."

An October 14, 1977 memo from T. Wall to S. Pawlicki also comments on TAP A-37.

Also memo from M. Taylor to S. Pawlecki dated September 3, 1976 addresses turbine missile.

54. Synopsis: In an October 14, 1977 memo, I. Wall sent J. Stolz comments on PAB's review of Diablo Canyon Amendment 52. The analyses in support of the Amendment and therefore these comments refer to component failure probabilities, and consequence models and results from WASH-1400. A December 30, 1977 memo from Wall to Stolz provides a draft SER input supporting Amendment 52.

55. Synopsis: In an August 3, 1977, memo I. Wall sent J. Knight comments on Task A-18, Pipe Rupture Design Criteria. The comments were based in part on the results of WASH-1400.

56. Synopsis: The June 20, 1977 and August 11, 1977 memo from S. Levine to R. Fraley transmitted calculations performed by PAB of of Control Room Doses for Postulated Core Meltdown Accidents. The doses were calculated for two accidents as characterized in WASH-1400.

57. Synopsis: The March 28, 1977 memo from Mat Taylor to Ian Wall transmitted viewgraphs on three ACRS generic issues which were to be used in an informal presentation to NRR. The viewgraphs used results and insights from WASH-1400.

58. Synopsis: Memo from I. B. Wall to V. M. Panciera dated July 9, 1976, Subject: Estimated Impact upon Public Risk Associated with a Non-inerted BWR Containment. This memo compares the risk associated with a non-inerted BWR containment to the risk associated with the inerted containment used in WASH-1400 and makes recommendations based on this analysis.

59. Synopsis: Battelle, Columbus prepared a report on the effect of engineered safety features on LMFBR risk due to accidents. WASH-1400 accident event trees were used in the analyses.

60. Synopsis: Memo from Vesely to Staley, DSE, from Vesely to Ayer and from Vesely to Burkhardt dated June 7, 1978 providing an analysis of flood frequency of the Kishiminetas River using WASH-1400 methods to develop a frequency curve.

61. Synopsis: Memo Buhl to Mattson dated September 21, 1978 provides RES comments on Supplement 1 to NUREG-0460. Methodology and insights from WASH-1400 were used in the recommendation to NRR.

62. Synopsis: The March 21, 1977 memo from W. Vesely to R. Baer, C. Berlinger, S. Israel, and J. McGough transmitted a description of the allowed downtime calculational approach used by PAB. Accident probabilities are used in the calculations.

63. Synopsis: The February 25, 1977 memo from S. Levine to B. Rusche and R. Minogue transmitted Research Information Letter-10, Pressure Vessel Failure Probability Prediction. The draft report compared the new failure probabilities with those predicted in WASH-1400. The report was only a draft and no licensing action was taken based upon it.

64. Synopsis: Memo from I. B. Wall to File, dated April 5, 1976, Subject: Minutes of Meeting held on April 2, 1976. Memo from I. B. Wall and W. E. Vesely to H. J. C. Kouts, dated March 16, 1976, Sugject: Comments on "Reliability Assessment of CRBRP Reactor Shutdown Systems" (WARD-D-0118, Riv. 1), November 1975. These memoranda discuss the role of probabilistic analysis in the licensing of the Clinch River Breeder Reactor Plant. The discussion with memoranda relied on WASH-1400 insights, data and analyses of similar LWR systems to assess the feasibility of the CRBRP Control System to meet the numerical goals set for it by the applicant.

65. Synopsis: Memo from Edison to Novak dated November 7, 1978 provided an assessment, using WASH-1400 techniques of changing the test frequency of the containment spray recirculation pumps. This assessment was used by the staff in its consideration on alternate testing scheme for the Surry pumps.

66. Synopsis: In September 1976, the Director, RES testified in a court proceeding related to the constitutionality of the Price-Anderson Act. His testimony covered what WASH-1400 was and its results. RES categorized this as a 1. Since absolute values of risk were not relied upon to make any specific licensing decision in this instance, NRR has classified it as a 3. It should be noted that the court ruled against the NRC in this instance, but was overruled by the Supreme Court. Further, as we understand it, the Supreme Court decision did not depend on the numerical risk estimates of the RSS.

67. Synopsis: Memo from Buhl to Mattson dated May 18, 1978 comments on proposed NRR study of missile impact effects on structured barriers. Memo compares proposed study with an attached event tree and concludes proposed study only covers a small part of total accident sequence probability. Memo uses WASH-1400 analyses to confirm RES conclusion on utility of NRR study.

68. Synopsis: The May 15, 1977 memo from S. Levine to R. Ryan discussed the Program Plan being developed by Sandia Laboratories on Emergency Planning and Response Evaluation. This work is based in part on the models and methodology of WASH-1400.

The NRC/EPA Task Force has used information in the RSS as a basis to perform calculations which illustrate the likelihood of certain offsite dose levels given a core melt accident. The results derived from the RSS based work serve to confirm the Task Force judgment that offsite planning for a generic distance around nuclear power plants is prudent and useful.

Memo from Levine to Ryan, SP, dated May 22, 1978 provides comments on draft NUREG-0396.

69. Synopsis: The May 17, 1977 memo from I. Wall to S. Eilperen transmitted comments on Judge McMillan's decision concerning Carolina Environmental Study Group, Inc., et al., v. United States Atomic Energy Commission, et al., U. S. D. C., W. D. N. C., No. C-C-73-139. The decision and comments relied on the WASH-1400 methodology and results.

70. Synopsis: As part of staff efforts regarding Seismic Scram, UCRL performed a study (UCRL-52156, "Advisability of Seismic Scram") which relied upon some WASH-1400 data regarding accident probabilities as a means of evaluating relative core melt probability with and without seismic scram. The staff has, as yet, taken no final action regarding this matter.

Memo from I. B. Wall to V. Panciera, dated April 15, 1976, Subject: Comments on the Advisability of Seismic Scram. These comments were based on WASH-1400 insights and results.

71. Synopsis: In the development of Branch Technical Position RSB 5-1 on Residual Heat Removal, (attached to SRP 5.4.7), the results of WASH-1400 were used to show the potential need for increased requirements for RHR systems. Neither the numerical data nor the methodology of WASH-1400 was used.

72. Synopsis: Efforts are underway to modify the existing NRC-FCI code and use it to calculate probabilities and consequences of steam explosions. Calculations of steam explosion consequences (but not probabilities) were performed for the FNP's documented in NUREG-0440; this study assumed that the steam explosion probabilities to be bounded by the WASH-1400 results.

73. Synopsis: Probabilistic techniques similar to those of WASH-1400 were used to perform a study of allowed outage times for ECCS components for incorporation in plant Technical Specifications. Data basically were used in a comparative sense.

74. Synopsis: In considering Task Action Plan B-68, the WASH-1400 probability values and analysis were used to determine the overall probability of core melt resulting from a PWR reactor coolant pump flywheel missile impacting on an ECCS line due to pump overspeed following a cold leg break. Furthermore, based on the PWR design assessed, missile impact during a LOCA would contribute less than 2% relative to the overall PWR core melt probability.

75. Synopsis: The probability of an SSE was extracted from WASH-1400 for use in an enclosure to the R^3C working paper on overpressure protection while operating at low temperatures. This probability was used to suggest that the probability of an overpressure event caused by an SSE while operating at low temperatures may not be a significant contributor to the overall frequency of overpressure events (as determined from actual operating data) and therefore should not be considered.

R^3C recommended that the overpressure protection system must be designed to withstand the operating basis earthquake (OBE). While the data from WASH-1400 was considered when determining the seismic requirements, it was not the primary basis for the R^3C decision.

76. Synopsis: WASH-1400 was examined for justification of the staff's proposed RHR Shutdown position (single failure/safety grade/seismic, etc.) to see if it did reduce the probability of core melt. It was found that the RHR position would not affect the WASH-1400 results since hot standby was considered to be a success path in WASH-1400. As noted in a January 19, 1978 memo, NRR concluded that: "No quantitative assessment was made of the reduction in risk that would result from the proposed improvement in the RHR system (SRP 5.4.7), and the effect of a loss of the RHR cooling on risk was considered small and hence not evaluated." In conclusion, the staff recommended implementation of the "RHR shutdown position."

77. Synopsis: In considering whether mechanical failure of isolation valve in RHR suction line would preclude activating RHR system in Diablo Canyon, a comparison was made of the probability of mechanical valve failure and SSE with the probability of core melt calculated in WASH-1400. We considered the valve failure probability acceptable because it was small compared to the WASH-1400 value. Moreover, steam generators provided alternate means of long term decay heat removal.

78. Synopsis: Using WASH-1400 values, we noted that the probability of a loss of offsite power at the time of the large loss-of-coolant accident is extremely unlikely (with a median value on the order of 10^{-7} per reactor year) and indeed is much less likely than several other scenarios considered in WASH-1400. Based on this low probability of occurrence, we concluded that the Shoreham response regarding recirculation pump trip was acceptable.

79. Synopsis: WASH-1400 is referenced twice regarding BWR rod drop accidents in a June 17, 1975 memo from H. Richings to D. Ross. In the first reference, the absolute values of accident probabilities for severe BWR accidents were used in a relative way to support the choice of a probability criterion such that the occurrence of the accident need no be considered a design basis event. It should be pointed out, however, that the primary basis for the choice of the criterion was WASH-1270 (ATWS). The reference to WASH-1400 was only supplementary in character.

The second reference to WASH-1400 was with respect to the probability of human error. Again the reference was supplementary in character and primary reliance for the estimate of the probability for human failure was not based on the reference to WASH-1400.

80. Synopsis: In considering grid frequency decay, we stated in NUREG-0138:

"Considering the likelihood of occurrence of excessive frequency decay and the release to atmosphere that would result from release of a portion of the total gap activity to the primary coolant system, an accident such as that postulated would represent a negligible portion of the reactor accident risk predicted in the Reactor Safety Study (WASH-1400)."

81. Synopsis: The staff relied on a probability analysis in developing its position regarding containment purging. No WASH-1400 results were incorporated in the analysis thus this is not a Category 1 item.

82. Synopsis: The justification of the need for Regulatory Guide 1.139, "Guidance for Residual Heat Removal," is based in part on the WASH-1400 result that showed the probability of core melt due to system and equipment failures that result in the inability to remove fission product decay heat is higher than the probability of core melt in the event of a large LOCA. Additional bases for the regulatory position of Regulatory Guide 1.139 are provided in the discussion, and it is the view of the staff that the position would be unchanged if the WASH-1400 results had not been considered. [Note that the use of WASH-1400 results is a conservative action; i.e., the need for increased safety is demonstrated.]

83. Synopsis: WASH-1400 estimates for fission product gap activity (Appendix VII) were used to affirm the use of Regulatory Guide 1.25 source terms in Regulatory Guide 1.89 to determine the radiation environment for qualifying electrical equipment. The more conservative source term of Regulatory Guide 1.25 was used in developing Regulatory Guide 1.89.

84. Synopsis: WASH-1400 was used to provide an estimate of the consequences of sabotage. However, the decisions to implement reactor sabotage regulations were not based on the WASH-1400 results but rather on the knowledge that sabotage could cause releases that would be harmful to the public. WASH-1400 is referenced in:

(1) "Safety and Security of Nuclear Power Reactors to Acts of Sabotage," SAND 75-0504 Sandia Laboratories, March 1976;

(2) Memo R. B. Minogue thru L. V. Gossick to B. Huberman, Director of Policy Evaluation transmitting a discussion of design threat levels entitled, "Basis and Rationale for Selections of a Design Threat Level for Power Reactors Sabotage Protection" prepared by SD staff, January 3, 1977;

(3) Transcript of the public hearings on the Material Access Authorization Program - "Rulemaking in the Matter of 10 CFR Parts 11, 50 and 70, Docket Rm-50-7, July 10, 11, and 12, 1978."

85. Synopsis: In denial of PRM 50-19, the calculated consequences of core meltdowns in PWR and BWR reactors were used to estimate the potential effectiveness of an evacuated containment to mitigate the effects of a Class 9 core meltdown accident. Risk assessment results and models (i.e., probability of the events) were not used.

86. Synopsis: In their responses of December 15, 1977 and July 6, 1978, to the Commission on the UCS petition for emergency and remedial action, the staff utilized the work of the Browns Ferry Review Group as reported in NUREG-0050. This group utilized the models of WASH-1400 to provide additional support to the staff position.

87. Synopsis: Supplemental Testimony of Darrell Eisenhut on Contention I-10, in the matter of Kansas Gas and Electric Company and Kansas City Power and Light Company, (Wolf Creek Generating Station, Unit No. 1), Docket No. 50-482, January 6, 1976. The contention is similar to the Callaway contention in Item 88 below. The conclusion regarding the draft WASH-1400 report is also the same as in the Callaway testimony.

88. Synopsis: Supplemental Testimony of the NRC staff on Contention I-7 and on Contention I-2g, in the Matter of Union Electric Company (Callaway Plant, Units 1 and 2), Docket Nos. STN 50-483 and STN 50-486. Contention I-7 alleges that the staff's analysis of the environmental impact for the proposed facility is inadequate because Class 9 loss-of-coolant failure of ECCS core melt accidents are dismissed without detailed analysis, in spite of the probabilities for such an incident being one in 17,000 per reactor year (WASH-1400). The staff testimony concluded that the draft WASH-1400 report did not present any information concerning the frequency of occurrence of the accident sequence described in Contention I-7 that alters the conclusion that the environmental risk of such an accident can be considered to be negligible and need not be considered further.

SYNOPSIS OF CATEGORY 4 ISSUES

1. Synopsis: The core melt evaluation for the CRBRP, FFTF and FNP are being reviewed and utilizing the molten core-concrete penetration evaluator models, data and results of WASH-1400 as guidance in the core melt evaluation assessments for FFTF, CRBRP and the FNP.

2. Synopsis: With regard to water hammer, there is no specific reference to WASH-1400 in Section 3 "Basis for Continued Plant Operation and Licensing Pending Completion of Task" of TAP A-1. However, the WASH-1400 estimates of pipe rupture probabilities have been considered along with data on pipe cracking or rupture obtained during the staff review of water hammer events. In view of the low probability of piping failure due to water hammer and the corrective actions being taken with respect to water hammer in PWR steam generators, continued operation and licensing of plants can proceed while Task A-1 is being conducted.

3. Synopsis: With regard to intersystem LOCA, WASH-1400 identified the intersystem LOCA in a PWR as a significant contributor to the risk resulting from core melt. The staff has analyzed this and other similar scenarios using the general methodology

and the data of WASH-1400. Memo dated July 3, 1978 from Buhl to Novak providing minor comments on NRR Intersystem LOCA Analysis. Minor changes in terminology and definition of terms were recommended. The staff analyses are limited to those sequences which are significant contributors to risk in relation with the WASH-1400 results. Using these analyses, the staff plans to determine leak testing frequency.

4. Synopsis: With regard to the use of probabilistic assessments of reliability, we stated in NUREG-0138 that:

"The staff agrees that present technology does not permit a rigorous demonstration of the WASH-1270 objective of 10^{-7} per reactor year. As shown by the Reactor Safety Study (WASH-1400), however, the use of a reactor protection system with a low unavailability, plus additional capability provided by other systems to limit transients, prevents anticipated transients without scram (ATWS) from being the predominant contributor to core melt probability for light water reactors (LWRs). The conclusion supports the staff position that an acceptable level of safety can be achieved by use of reliable transient-limiting systems in conjunction with a highly reliable reactor protection system."

5. Synopsis: With regard to protection against single failures in reactivity control system, we stated in NUREG-0138 that:

"The release to the environment resulting from such release of gap activity to the primary cooling system would represent a negligible contribution to the reactor accident risk predicted in the Reactor Safety Study (WASH-1400). An in-depth review of the analyses has not been carried out since the transients have not been generally judged to be a Condition II event and the reviews have been commensurate with the apparently small safety significance of the event. The analyses which have been submitted, however, have been reviewed and none have been found unacceptable."

6. Synopsis: The RSS consequence model (CRAC code) was used to calculate consequences of a core melt at the GETR. Results were transmitted informally to and at the request of PSS/NRR. Not documented and approach abandoned.

7. Synopsis: As part of evaluation of Diablo Canyon for interim license (which has not been used) the Probabilistic Analysis Staff prepared a summary evaluation of the risk of operation of Diablo Canyon for a range of probabilities of a seismic event.

8. Synopsis: Memo from I. B. Wall to E. G. Case, dated June 29, 1976, Subject: Proposed Regulatory Guide 1.108, "Periodic Testing of Diesel Generators Used as Onsite Electric Power Systems at Nuclear Power Plants. This memo provides comments on the proposed Regulatory Guide from the standpoint of overall public risk based on diesel generator unavailability.

9. Synopsis: In Exhibit A, Section 6, Part IV of the Nuclear Energy Center evaluation an accident risk analysis is provided utilizing the methodology of WASH-1400 and data modified by the staff to reflect the specific design considerations of a nuclear park.

10. Synopsis: Memo from Edison to Novak dated November 7, 1978 providing comments on the probability of a LOCA plus loss of offsite power. Comments of the Lewis Committee were available and reflected in the memo when the response was prepared.

11. Synopsis: Memo from M. A. Taylor and W. E. Vesely to I. Wall, dated August 6, 1975, Subject: BWR Rod Drop Accident. This memo uses WASH-1400 methodology to analyze the rod drop accident for the ten oldest BWR reactors.

12. Synopsis: The staff is presently reevaluating the effectiveness of existing transportation regulations in protecting the health and safety of the public. To a very great extent, that reevaluation is depending on quantitative risk assessment. There is, of course, little in common between reactor accident probabilities and transportation accident probabilities. But there is some similarity in accident consequences and post-accident cleanup between the two. Therefore, the staff is using the consequence analysis portions of WASH-1400 in the transportation analyses. These uses are documented at this time in NUREG-0170 (Vol. 1) and a Sandia contractor report SAND 77-1927. The Sandia report is a precursor of a staff environmental statement.

The staff use of quantitative risk assessment in general, and WASH-1400 material in particular has been cautious and critical. Some aspects of the staff's questions on the validity of this risk assessment are addressed specifically in the overall summary and conclusions of NUREG-0170 (Vol. 1, p. ix). No rulemaking action has yet been taken on the basis of these risk assessments.

SYNOPSIS OF CATEGORY 5 ISSUES

1. Synopsis: The staff utilized the event tree/fault tree methodology of WASH-1400 to evaluate the reliability of the CRBRP Shutdown Heat Removal System. This evaluation was used in parallel to the staff's deterministic approach (i.e., diversity, redundancy, etc) and provided additional insight on design changes and their contribution to achieving the required diversity and redundancy to meet the applicable General Design Criteria.

2. Synopsis: A study of comparative risk evaluations for advanced reactors is being done utilizing WASH-1400 type methodology. The objective of this work is to provide early guidance on the licensability (i.e., conformance with the well-established regulatory criteria and practices) of a given advanced reactor relative to the present generation of LWRs.

3. Synopsis: Section 7.1.2.5 of the Report to ACRS on RESAR-414 describes the Westinghouse design verification program for the Integrated Protection System (IPS). The program will include a system reliability analysis based upon techniques similar to those in WASH-1400. Staff reviewers should be alert for reliance on absolute values from WASH-1400.

4. Synopsis: A study of systems interactions in advanced reactors uses event and fault trees and involves an evaluation of methods and techniques available for a qualitative and quantitative study of systems interactions and common mode failures.

5. Synopsis: References to WASH-1400 were made on page 65-4 of the testimony on ATWS for the Black Fox hearing. WASH-1400 also is mentioned on pages TAP-38 of the testimony regarding Task B-34 and on page A-37/9 of the Task Action Plan for Task A-37. In none of these cases was specific information from WASH-1400 relied upon.

6. Synopsis: WASH-1400 methodology was used for a preliminary analysis of the ANO-2 core protection calculator system. The analysis was not used in the final decision on ANO-2. Similar methodology was used in evaluation of reliability of B&W RPS-II and Westinghouse IPS. None of these analyses has been used or referenced in a licensing action.

7. Synopsis: Operator error data was extracted from WASH-1400 to assist in evaluating the potential for an overpressurization event to occur while the DHR relief valves were isolated. However, the use of the WASH-1400 data was not the basis for the acceptance of any design.

8. Synopsis: A WASH-1400 type analysis was used as a partial basis for recommending only manual seismic fire protection capability in new plants and for not backfitting operating plants or plants under construction.

9. Synopsis: In the staff response to a Board question (North Anna, Units Nos. 1 and 2), reference was made to Regulatory Guide 1.120, which includes the following statement:

"Although WASH-1400, Reactor Safety Study, An Assessment of Accident Risks in U.S. Commerical Nuclear Power Plants, dated October 1975, concluded that the Browns Ferry fire did not affect the validity of the overall risk assessment, the staff concluded that cost-effective fire protection measures should be instituted to significantly decrease the frequency and severity of fires and consequently initiated the development of this guide."

10. Synopsis: Probability was used as a rationale to:

1) justify break exclusion for "super pipe,"
2) determining failure mode difference between high and moderate energy piping i.e., breaks vs. cracks, and,
3) justify exemption of single active failures for certain piping systems.

Probability was also used as a partial basis for excluding certain primary piping breaks from consideration as CDA initiators in Clinch River and FFTF.

11. Synopsis: Diesel generator reliability operating experience was used as a probability data base coupled with probability of loss of offsite power to support the staff position on requiring diverse power supplies for auxiliary feed systems. (Note: Draft of proposed ANS 51.1 references WASH-1400 as basis for two hour maximum period for loss of offsite power.)

12. Synopsis: The working paper for Regulatory Guide 1.63 regarding electrical penetrations for pump power supplies in containment included the following statement:

"We have performed a probabilistic analysis using the above failure data (failure rate calculated at the 95% confidence level); the established LOCA probability of 10^{-4} per reactor year; and conservative assumptions regarding the time intervals during which the pump penetrations would be subject to failure (while energized) given that a LOCA occurred first, or during which a plant is subject to a LOCA (while not a cold shutdown) given that a pump penetration failure occurred first. Our detailed calculations are shown in Enclosure 2. The results of this analysis indicate that the probability of a LOCA concurrent with a pump penetration short circuit failure is less than 3.6×10^{-9} per year. This is considered to be an insignificant risk to the public health and safety. In our opinion a regulatory requirement directed toward reducing this risk cannot be justified, and may in fact have a negative impact on safety by diverting both applicant and staff resources form matters of greater safety significance."

13. Synopsis: In the description of Generic Issue Task Action Plan A-25, the following statement is included:

"The approach selected for problem resolution is that of a reliability analysis of typical plant onsite Class IE power systems."

14. Synopsis: The "break exclusion region" for piping systems penetrating containment contained in Stnadard Review Plants 3.6.1 and 3.6.2 is based on the premise that probability of pipe rupture in this region has been reduced when compared with that of a "non-break exclusion region."

15. Synopsis: In our study to assess the effects of postulated event and devices (snubbers) on normal piping system operation, the probability of deleterious interaction of such devices with the piping system will be quantified.

16. Synopsis: During the period in which generic activity on Task Action Plan A-2 regarding asymmetric loads on RV supports was progressing, several plants were licensed prior to the completion of our complete evaluation based on scoping calculations, design conservatisms and the low probability for pipe rupture. This represents a subtle qualitative use of WASH-1400 without a definite value being stated, that the probability of a primary loop pipe rupture is low.

17. Synopsis: It is expected that our future work dealing with responses to dynamic loadings will use probabilistic techniques for combination methods, or as the rationale for decoupling.

18. During a general review of the turbine missile problem, we performed a risk assessment review of the valves which are part of the turbine control system. Based on data which was available, a failure probability as a function of valve inspection frequency was determined for use in the overall turbine missile study.

19. Synopsis: Letter to Senator Case dated October 2, 1978 referencing low probability of core melt accidents.

20. Synopsis: In a talk by Dade Moeller of ACRS, re: Containment Spray System Failures, LER data were compared to WASH-1400 failure data by a present AAB member, although prior to his joining the Branch.

21. Synopsis: LASL under technical assistance contract to the NRC is using fault tree and event logic in analyzing nuclear plant vital areas as part of the security plant review. Fault trees from WASH-1400 have been used as part of the overall logic structure. No numerical estimates from WASH-1400 have been used. The results of the evaluation are transmitted from LASL to RSLB in a letter report that is withheld from public disclosure in accordance with 10 CFR 2.790(d). The site specific fault trees/event trees are classified as Confidential NSI and are kept in approved security repositories at either LASL or RSLB.

22. Synopsis: In SECY 77-388A, the staff proposed guidelines for the preparation of Value-Impact analysis. In an example of where further action may be needed, WASH-1400 techniques were referenced as the type of analysis that could be conducted.

23. Synopsis: Memos from I. B. Wall to G. A. Arlotto dated June 30, 1975 and July 3, 1978. Subject: IEEE/NPEC/P577, Draft 1, "Reliability Requirements in the Design and Operation of Nuclear Power Generating Stations." This memo presents detailed comments on the above cited draft. The comments relied on insights from WASH-1400.

24. Synopsis: Letter from H.J.C. Kouts to W.D. Rowe, EPA dated July 7, 1978, regarding Emergency Response Protective Action Guides. This letter forwards comments to EPA on the Protection Action Guides. The comments relied on insights from WASH-1400.

25. Synopsis: Memo from S. Levine to V. Stello dated June 24, 1976, Subject: DOR Re-review Program for Operating Nuclear Power Plants. This memo discusses the difficulty of applying risk assessment to the re-review program. The memo relied on WASH-1400 insights.

26. Synopsis: Memo from S. Levine to H. Lowenberg dated July 23, 1976, Subject: Review of GESMO Chapter IV, Section C. This memo provides comments on the environmental risks associated with Class 1-9 accidents.

27. Synopsis: Memo from I.B. Wall to T.R. Wilson dated December 13, 1974, Subject: Statistical Analysis of Diesel Failure Data. This memorandum encloses a report on statistical tests performed on data obtained or diesel generator performance. The methods used are similar to those that were used to evaluate data in WASH-1400.

28. Synopsis: Memo from W.E. Vesely to A.C. Thadani dated September 23, 1976, Subject: Review of EPRI Report "ATWS Reappraisal" (EPRI NP-251). The memo relies on techniques similar to those in WASH-1400 to criticize the EPRI report.

29. Synopsis: Memo from S. Levine to R. Boyd dated October 8, 1976, Subject: Responses to NRDC et al Fourteenth Set of Interrogatories in CRBRP proceeding. This memo relies on insights from the Reactor Safety Study to respond to interrogations.

30. Synopsis: In a January 19, 1977 memo, S. Levine sent comments to G. Arlotto on the Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes. In the memo reference was made to the risk assessment contained in the EIS. Also, use of data from WASH-1400 instead of from the BEIR report was criticized.

31. Synopsis: Memo from I.B. Wall to S.H. Smiley, dated July 30, 1976, Subject: Review of "National Security and Accident Recovery Considerations of Nuclear Energy Center (NEC) Siting," by G.A. Cristy, C.V. Chester, and R.O. Chester, ORNL-5036. This memo provides comments on the above cited report and relied on insights from WASH-1400.

32. Synopsis: The June 16, 1977 memo from S. Levine to E. Case and R. Minogue transmitted RIL-12, Modifications to Pressure Vessel Failure Probability Prediction. The draft reports contained sensitivity studies on the effects of the new modifications and updated failure probabilities.

33. Synopsis: In a June 14, 1977 memo I. Wall sent to D. Skovholt the result of PAB's review of the Study of NRC QA Programs by Sandia Laboratories. The comments delt with the reliability analysis and probabilistic techniques used in the study.

34. Synopsis: The November 9, 1977 memo from S. Levine to E. Case transmits RIL-18 on the FRANTIC Computer Code. The code calculates system unavailability.

35. Synopsis: In a November 17, 1977 memo I. Wall sent I.C. Roberts comments on N-635, Draft 3, Guidelines for Combining Natural and External Man-Made Hazards at Power Reactor Sites. PAB criticized the probability and risk assessments used in the draft Standard.

36. Synopsis: In a July 26, 1977 memo M. Taylor sent S. Pawlicki comments on a paper by S. Bush titled, "A Reassessment of Turbine Failure Probability." No specific mention of WASH-1400 is made.

37. Synopsis: In a July 27, 1977 memo I. Wall sent R. Moore comments on a proposed contract with Control Analysis Corporation. The study would furnish methods for predicting the probability of the coincident occurrence of several natural or man-made hazards to nuclear power structures, systems and components.

38. Synopsis: In an August 23, 1977 memo W. Vesely transmitted information on probabilistic analyses of test interval effects to V. Nerses. The information addressed system unavailability and relied on WASH-1400 insights.

39. Synopsis: Memo from Buhl to Mattson dated February 3, 1978 provides comments on Draft III of Appendix 2 of the NRR report on ATWS. Specific comments related to the scram failure synthesis models.

40. Synopsis: Memo from Buhl to Mattson dated March 20, 1978 provides comments on ATWS Draft III. Principal remarks deal with the conservatisms used in the analysis as well as models used.

41. Synopsis: Memo from Buhl to Kehnemuyi dated April 20, 1978 provides comments on criteria contained in ANSI-N658 on single failures. Comments discuss the use of probabilistic technology and recommend concurrence in proposed ballot.

42. Synopsis: Memo dated January 23, 1978 from S. Levine to E. Case providing RES comments on the draft working paper of the Liquid Pathway Generic Study. Principal comments related to WASH-1400 methods used in the LPGS.

43. Synopsis: An April 12, 1978 report to Congress on research to improve LWR safety utilized the methodology to help establish what research should be accomplished to improve reactor safety.

44. Synopsis: In a November 23, 1977 memo S. Levine sent E. Case comments on a proposed information paper, Use of RSS Consequence Model in Evaluations of Alternatives to Sites With High Population Densities. The comments relied on insights gained from WASH-1400.

45. Synopsis: Memo from W.E. Vesely to G.S. Vissing dated December 18, 1975, Subject: Regulatory Guide "Periodic Testing of Diesel Generators Used as Onsite Electrical Power Systems at Nuclear Power Plants." Evaluations were performed to determine the reliability and risk implications of the proposed testing scheme. Analytical techniques were used that are similar to those used in WASH-1400.

46. Synopsis: Memo from I.B. Wall to R.B. Minogue dated March 4, 1976, Subject: Minutes of Meeting Held on 3/1/76 to Discuss Degree of Conservatism in the Draft Environmental Impact Statement on the Transportation of Radioactive Materials. Comments were based on techniques and insights from WASH-1400.

47. Synopsis: Memo from S. Levine to R.E. Heineman dated March 26, 1976, Subject: Examination of the Seismic Design Basis for Fire Protection Systems. This memo provides an analysis directed to the question of whether fire protection systems should be designed to seismic Category I systems. Improved data obtained since publication could modify results and widen error bounds but the general conclusions would be expected to remain valid.

SYNOPSIS OF CATEGORY 6 ISSUES

1. Synopsis: "Report on the TVA Seismic Issue by NRC Staff Working Group" considered, but recommended against, use of WASH-1400 as an aid in determining seismically-induced core melt sequences. The use of WASH-1400 was considered, but rejected.

2. Synopsis: Additional remarks by ACRS member Dr. Okrent in the Committee's Report on Perkins/Cherokee (April 14, 1977) included a comment about the estimates of the contribution of earthquakes to overall nuclear reactor safety risk, as given in the Reactor Study (WASH-1400). The Hearing Board then requested written material that addresses the reservations of ACRS member Okrent. Written material pertaining to quantification of inherent safety margins on seismic design was provided. During the hearing, the Board pursued the question of how the staff rationalizes their position on setting the design basis earthquake against the probabilities. As staff witness, C. Moon stated that the staff id review a draft of WASH-1400 and did make comments, but that the

staff has not then (July 21, 1977) adopt that report or any similar procedure on its licensing review actions.

3. Synopsis: In the rulemaking hearing for 10 CFR 11 held in Washington, D. C., on July 12, 1978, the staff referred to the "consequence tables" in WASH-1400 during presentation of testimony. The staff also referred to data in WASH-1400 which compares the consequences of other disasters to postulated events at a nuclear plant. (See pages 422-557 of transcript.)

In responding to Mr. Gossick's request, NMSS stated, "... the NMSS staff believes that they have taken no licensing or regulatory actions which have relied on the risk assessment results and models of WASH-1400." They did identify the following two issues that made "remote" reference to WASH-1400.

4. Synopsis: Basic data referenced in the draft WASH-1400 concerning natural gas pipe line failure rates was used in the preparation of the environmental statement on the Bear Creek Project of Rocky Mountain Energy Company, Docket No. 40-8452. However, such data would have been available and might have been used by the NMSS staff whether or not it had also been used in WASH-1400.

5. Synopsis: Draft input in the Seabrook alternative site review contains results of limited studies that led the staff to conclude that population density is a sufficiently crude indicator that relatively large differences in population densities between two sites would be required before significant differences in residual risks at these sites could reasonably be expected.

6. Synopsis: Commissioners information cards contain information related to risks from various non-nuclear and nuclear accidents. Data used was compared to WASH-1400.

7. Synopsis: The Annual Reports for 1975, 1976, 1977 and 1978 discuss WASH-1400 and some uses of the results.

8. Synopsis: An extract from the November 18, 1978 issue of National Journal discusses the Rasmussen Report.

9. Synopsis: A December 8, 1978 memo from Levine to Denton provides three additional items identified by RES that utilized the insights of WASH-1400. They are a letter to Senator J. Glenn dated December 9, 1976 and copies of NUREG-0138 and NUREG-0153. The letter to Senator Glenn provides responses to questions about the discussions by NRR of issues in NUREG-0138. Specific issues of NUREG-0138 and NUREG-0153 are discussed elsewhere in this enclosure. The letter to Senator Glenn is considered as a Category 2 issue not deserving reconsideration.