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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

April 24, 1980

MEMORANDUM FOR: Chairman Ahearne
Commissioner Gilinsky
Commissioner Kennedy
Commissioner Hendrie
Commissioner Bradford

FROM: Edward J. Hanrahan

SUBJECT: OPE EVALUATION OF THE IMPACT OF POST TMI-2 NRC REQUIREMENTS ON B&W REACTORS AND THE CRYSTAL RIVER TRANSIENT

I. INTRODUCTION

On February 28, the Commission directed the Office of Policy Evaluation to make an independent evaluation of the impact on B&W reactors and on the Crystal River event of the post-TMI-2 requirements. In making its appraisal, OPE considered all of the post-TMI-2 requirements -- including the Short Term Lessons Learned Task Force (NUREG-0585) as well as bulletins, orders, and letters related to the TMI-2 accident. In the course of performing this evaluation, we had discussions and meetings with the NRC staff and B&W engineering staff. On a site visit, we also met with Florida Power at the Crystal River Unit and Duke Power at their headquarters in Charlotte. We received substantial technical assistance from Dr. M. A. Schultz, a professor in the Department of Nuclear Engineering at Pennsylvania State University. There is clearly some overlap between the scope of our review and that of the recent B&W Task Force Report: Transient Response of B&W Reactors (NUREG-0667). Accordingly, I have commented on the B&W Task Force recommendations in several instances where they are directly pertinent to the Crystal River transient.

We prepared a comprehensive list of post-TMI-2 NRC requirements, the status of implementation of the requirements at Crystal River on February 26 and brief statement of our assessment of the impact of each requirement on the February 26 transient. This compilation is presented in Appendix A. The OPE staff encountered difficulty in compiling this comprehensive list of requirements since no single individual or organization knew all that had been required of B&W reactor licensees. Several independent groups were responsible for analysis and development of new NRC requirements after the TMI-2 accident -- the Bulletins and Orders Task Force and the Short-Term Lessons Learned Task Force, and more recently, the B&W Task Force formed in response to the Crystal River event. In addition, TMI-2

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related requirements were set forth in various letters from the Office of Nuclear Reactor Regulation. Appendix A is subdivided into six sections, representing five different sources of requirements to licensees.

After the TMI accident, attention to new TMI-related requirements has tended to diminish the role of the operating reactor project managers. While the purpose of this report is not to examine organizational alternatives, our experience in preparing it leads me to recommend that the Commission consider strengthening the existing project structure (as was done for the TMI-2 cleanup program) by assigning the NRC manager the responsibility for coordinating the implementation of all NRC requirements, license and technical specification amendments, etc., on reactors. This would consist of an individual or organization who would be completely familiar with the status of a reactor and who would coordinate NRC requests and requirements on the licensee. If the project manager were also organizationally or functionally connected with regional office staff, then there would be greater likelihood that NRC would speak with one voice to licensees.

It should be noted at the outset that many of the post-TMI-2 requirements were not directly relevant to the Crystal River transient because of the particular sequence of events. However, some of the new requirements would have provided for protective measures that would have been effective if a different sequence of events resulted in an accident of serious consequences (i.e., high radiation release following fuel failure).

The overall net effect of the approximately 80 post-TMI-2 requirements was a positve contribution to improved safety. In particular, operator training programs which addressed the handling of TMI-type transients directly contributed to mitigating the Crystal River transient. A direct negative contribution of the requirements was the initiation of the transient by an improperly installed, newly required saturation meter.

The following sections summarize the highlights of Appendix A. Section II discusses operator training and procedures, simulators, and the potential impact of NRC requirement changes on operator training. In Section III the effect of instrumentation and hardware requirements are reviewed. Comments relevant to the overall picture on post-TMI-2 NRC requirements are included in section IV.

II. OPERATORS

1. Operator Training and Procedures. The post TMI-2 requirements of licensees in the areas of operator training, qualification, and improved procedures were of material assistance in managing the reactor during the transient and bringing it to a safe shutdown

condition. While the effectiveness of operator response during a reactor transient is difficult to assess quantitatively, both the industry and NRC staff have stressed the positive value of the TMI lessons learned in the operator management of the Crystal River transient. During the loss of a major fraction of control room instrumentation, operators maintained adequate core cooling by continuing operation of the high-pressure injection system and by prompt isolation of the power-operated relief valve (PORV).

A comparison (Table 1) of operator response during the Crystal River transient vis-a-vis TMI-2 shows the times involved in some of the key actions in both accidents. Although the initiating causes of the two accidents were substantially different, there were similarities in their early stages. For example, both accidents involved reactor trips within seconds with associated over-pressurization of the reactor coolant system. However, operator actions, following revised procedures required since TMI-2, provided for effective management of the Crystal River transient. In addition, NRC-required operator training paid off. Specifically, the Crystal River operators recognized the need to isolate the PORV in response to a high drain tank alarm signal and, by doing so within a few minutes after reactor trip, eliminated the possibility of a loss of reactor coolant through the PORV. The Crystal River operators also acted to ensure reactor core coverage by keeping the high-pressure injection pumps operating at full flow until instrumentation was restored and reactor subcooling could be verified.

The requirements that licensees perform transient analyses and develop relevant emergency procedures and training (from the Short Term Lessons Learned) contributed to operator competence during the Crystal River transient. In particular, the operators used the new procedures to determine and track saturation conditions and to verify establishment of natural circulation in the reactor coolant system.

Because of the high payoff from more operator training in off-normal procedures, I support the B&W Task Force recommendation that generic guidelines be developed to help the operators in the event of loss of non-nuclear instrumentation and integrated control system power. These should be available to assist the operators in the event of power bus failures even if a safety system actuation or reactor trip does not occur.

TABLE 1

COMPARISON OF HIGHLIGHTS OF CRYSTAL RIVER EVENT (FEB. 26, 1980) TO CORRESPONDING EVENTS DURING THE TMI-2 ACCIDENT

Time[1]	
0	Initiating event at Crystal River was the loss of an instrumentation and control electrical bus caused by a short circuit in a saturation meter. About half of the normal control room instrumentation indication was lost. (Note: Initiating event at TMI-2 involved blockage in the condensate polisher system.)
0	Feedwater pumps cut back because of an improper instrumentation signal created by instrumentation power bus failure.
14 seconds (8 seconds)	Automatic reactor trip on high pressure followed by turbine trip. (Note: Reactor trip occurred 6 seconds earlier at TMI-2.)
2 mins 29 sec (2-1/2 hours)	PORV isolated by operator in response to a high drain tank alarm (Note: Slow operator response was a direct contributor to the severity of the accident at TMI-2.)
3 mins 20 sec (2 mins)	HPI actuated upon low pressure signal. Operator continues HPI with no throttling. Reactor building sump isolated manually. (Note: HPI throttled by operator at 4-1/2 minutes into the accident at TMI-2 causing a loss of needed core coolant.)
9 mins (8 mins)	Operator starts emergency feedwater pumps. (Note: At TMI-2 blocked feedwater valves were opened at this time.)
20 mins	Power to instrument bus restored at Crystal River. Instruments now operative.
20 mins (1 month)	Natural circulation verified.
21 mins 8 sec (30 mins)	Reactor building isolated.

[1] Time for corresponding operator action or event at TMI-2 sequence is shown in parenthesis ( ) beneath the time at Crystal River.

2. Simulator Training and Operator Training - The simulator training requirements proved especially beneficial in giving the operators experience in managing the reactor under a wide variety of conditions, including under- and over-cooling events, solid system operation, and the establishment and verification of natural circulation. In addition, during the Crystal River transient, the operators through a communication link to B&W at Lynchburg were able to utilize the B&W simulator to predict plant response to proposed operator actions. These predictions proved to be reliable and helped to guide the operators through the transient. Thus, in the light of the experience of the Crystal River transient, I support the B&W Task Force's recommendatic that additional simulator training be required of operators at B&W plants.

3. NRC Requirement Changes - Despite the apparent improved performance of the operators, the changes in NRC requirements related to operator training may be a source of confusion. For example, IE Bulletin 79-05 issued immediately after the TMI accident required that, in the event of high-pressure injection initiation, procedures were to be changed to assure that at least two main reactor coolant pumps were running. At Crystal River, operator training programs were altered to reflect this new NRC requirement and the bases for the change were explained to the operators. IE Bulletin 79-05C, issued last July and based upon analyses submitted by vendors, required that in the event of high-pressure injection the operation of all main cooling pumps was to be immediately terminated. The Crystal River plant superintendent reported that, in response to the latter bulletin, operator retraining ensued and a new technical justification was given to the operators. This reversal of position not only makes training difficult but undermines operator confidence in the validity of the procedures. During the February 26, 1980 incident, the latter requirement was in effect, and the main coolant pumps were tripped upon high-pressure injection initiation. The B&W Task Force now recommends that this point be studied further by NRC and industry, and it is possible that the instructions might again be changed. Such changes have the potential for creating confusion in the minds of the operators regarding the proper course to follow in a future emergency. In any event, new or changed procedures should be thoroughly and systematically analyzed before they are required to avoid this undesirable situation. Therefore, I recommend you require new or changed requirements be subjected to a rigorous analysis before implementation by staff.

4. Shift Technical Advisor - The shift technical advisor played a helpful role during the course of the transient. At Crystal River, each shift technical advisor is a senior reactor operator respected by the

reactor operators and is active in the operators' training program. For the advisor to be an effective member of the control room staff, he must be respected and must help train operators.

As a result of the TMI-2 related changes, the Crystal River operators are now receiving regular refresher courses and training every fifth week.

III. INSTRUMENTATION AND HARDWARE

Many of the new NRC requirements for supplementary instrumentation and hardware changes did not contribute significantly to the manageability of the Crystal River transient. The reasons were that either (a) newly installed instrumentation and hardware which would have been important in a more severe accident (e.g., like TMI-2) were not called upon because of successful operator actions at the outset or (b) equipment which could have been useful at Crystal River had not yet been installed. An example in the former category is the high-range radiation monitoring instrumentation which could have been needed following an accident involving failed fuel rods. An example in the latter category is ultrasonic instrumentation which would have provided control room indication of PORV and safety valve position by monitoring downstream flow.

1. Saturation Meter - The operators used the four operative saturation meters during the course of the transient. In contrast to TMI, the meters indicated temperature and pressure regimes that could be followed at all times to ensure that the reactor maintained an adequate subcooling margin. Recognizing the advantage of monitoring reactor subcooling, plant staff had built a special output display unit using an oscilloscope to clearly show in analog form the thermodynamic path of the transient.

   Nonetheless, it should be noted that the immediate cause of the Crystal River transient was short circuit of the non-nuclear instrumentation (NNI) power buss caused by improper installation of a buffer card which isolated signals to the saturation meter.* The short circuit

*The card was installed into a receiving slot at a slight angle such that mating pins on a connector were misaligned with a set of flexible socket sleeves. The resulting misalignment created extremely small clearances between pins, and between an end pin and a grounded bolt head. The instrument technicians at Crystal River were familiar with similar buffer cards and installation instructions were available. However, the installation apparently had to be made blindly; that is, the module into which the card was inserted was not completely withdrawn from the containing rack, and the installation technician could not see that the pins and their sleeve sockets were improperly mated. The actual short circuit did not manifest itself until approximately 2 weeks after the card installation. Possibly as a result of vibration of creep, the pin shorted against the chassis bolt head.

resulting from the misalignment of the circuit illustrates the extreme vulnerability of the "X" and the "Y" NNI busses. In this regard, the B&W's Integrated Control System Reliability Analysis (BAW-1564) of last August recommended corrective measures be taken on NNI power supply busses. Moreover, the recent NRC B&W Task Force recommends dividing the power supply busses into smaller power blocks. I support the Task Force's recommendations in this area.

2. <u>Safety System Challenges</u> - Two post-TMI requirements, which were not directly pertinent to the Crystal River transient, may in the long term have safety implications for Crystal River and other PWRs. The Short Term Lessons Learned requirements include the inversion of the set points of the PORV and the primary loop high pressure reactor trip. With the original settings, the PORV would relieve pressure first and, if the pressure relief were insufficient, high-pressure trips would shut down the reactor and further reduce system pressure. Because of the "sticking open" problem with PORVs, the set points were required to be inverted, i.e., the high-pressure reactor trips would actuate first. This change in effect alters the original operational and design philosophy of the B&W plants and causes additional challenges to the reactor safety systems.

   A related issue is the initiation of an anticipatory reactor trip following a turbine trip, which was a requirement from the Bulletins and Orders Task Force. Turbines may trip for various reasons, only some of which might result in the need for tripping the reactor. According to the B&W Task Force report the number of reactor trips now being experienced as a result of turbine trips has substantially increased since the implementation of this NRC requirement. The industry representatives with whom we met believe that B&W reactors can safely "ride through" a number of types of turbine trips without the necessity of a reactor trip. I believe that challenges to the reactor safety systems should be minimized and used as a last line of defense rather than for routine transient control. Thus, I recommend that these post-TMI requirements -- inversion of PORV and high-pressure trip set points and anticipatory reactor trip following turbine trip -- should be re-evaluated in the light of recent experience, considering all the implications of these requirements.

   Another matter is the particular sequence of events at Crystal River which led to lifting the code safety valves. After high-pressure injection had begun, and the PORV had been isolated the only primary system pressure relief was through the code safety valve. Although the code valves are designed to pass steam, water was forced through them during the transient. The possible valve seat erosion by water or two-phase flow (steam and water) through the code safety valves is not known. I believe that the staff is planning to study this possibility. This sequence results in part from new PORV set points and the requirement to isolate the PORV. I believe the lifting of code safety valves should be minimized if for no other reason than the inability to isolate them should they fail to reseat. Thus, I believe analysis of this matter by the staff is warranted.

IV. ADDITIONAL COMMENTS

During the course of preparation of this report, certain issues surfaced which while not directly relevant to the Crystal River incident, are nonetheless germane to post-TMI NRC reactor safety requirements.

1. Implementation Schedules for NRC Requirements - In the effort to expeditiously put in place new NRC requirements following the TMI accident, the staff appears to have given insufficient consideration to setting implementation schedules that would allow for the highest quality engineering practice. In our discussions with industry representatives, we were informed that the accelerated implementation schedule for many of the post-TMI requirements has precluded a thoroughgoing systems evaluation. Limited architectural engineering assistance was available to Florida Power Corporation to make the required changes in time. Manpower constraints also caused B&W to be hard-pressed to perform all NRC-required analyses. As a consequence, both Florida Power and B&W missed some of the implementation deadlines. A specific example of the scheduling problems with the saturation meter and the associated buffer card is given in Appendix B. The constraints on manpower to carry out all the required work appears to have been endemic throughout the utility, A/E, and reactor manufacturing industry.

   Of course, the need for quick NRC action is understandable given the urgency following the TMI accident both to assure public safety and to avoid unnecessary shutdown of the Babcock and Wilcox power reactors. An incidental complaint expressed by utility representatives was that the NRC staff, while insisting on prompt licensee action, did not itself provide expeditious action on licensee submissions (e.g., staff reactor analysis required of licensees often on short schedules). The licensees also stated that the regional staff and resident inspectors had a better appreciation for operational matters and licensee ability to implement new requirements than did the NRC headquarters staff. I recommend that the Commission instruct the staff to set implementation schedules for NRC requirements which allow licensees as well as the NRC staff enough time for in-depth engineering evaluation and design, for procurement of high quality equipment, and for its proper installation. Close coordination by headquarters with regional and resident inspection staffs should also be required.

2. Need for Systems Approach - Since the TMI-2 accident, many individual requirements have been placed on licensees without the benefit of an integrated systems analysis. Each new requirement appea.s beneficial by itself, but no systems analysis of the totality of the requirements has been made. In addition, the basis for a new requirement has not always been given and the requirement itself is often prescriptive -- the cure is given without explaining the problem being treated. For instance, the Short Term Lessons Learned requirement that licensees at Crystal River and other plants provide high point vents for both the reactor coolant system and the reactor vessel may be an illustration of where NRC requirements are overly prescriptive and do not allow sufficient flexibility. The industry representatives with whom we met said that the venting requirements are an example of an instance where the staff would be better served by defining those accident conditions which the staff wants venting to mitigate and then having licensees propose the specific venting arrangement applicable to their plants. They are concerned that the additional valving on the reactor coolant pressure boundary is not warranted. Venting requirements for noncondensible gases may reduce rather than increase reactor safety margins. Industry representatives are of the opinion that remotely controlled vents on the B&W "candy cane" piping to the steam generators may be adequate during the majority of potential transients and that vents in the reactor head may not be needed and, indeed, may be undesirable. I believe that NRC needs to make greater use of system engineering techniques, probabilistic analyses, event trees, and fault trees and less use of deterministic methods. Also NRC requirement of licensees should be functional rather than prescriptive.

3. The Use of Non-Safety Grade Equipment - The new saturation meter that was required to be installed quickly was to be control-grade equipment rather than safety-grade equipment. Considerable discussion has taken place within the Commission staff and industry as to the merits and feasibility of using safety-grade equipment for non-safety functions. Interestingly the new hardware installations recommended by the B&W Task Force all specify-safety grade equipment. Philosophically, this position appears correct -- if a change is being ordered because of a safety deficiency or implication, the new change should be manufactured to the highest safety-grade standards (except where seismic qualifications render safety-grade specification impractical).

   For instance, if the saturation meter had been designated as safety-grade, the Crystal River transient might have been avoided altogether. If the saturation meter had been safety grade, a proper Failure Mode and Effects Analysis may have been required to be performed on this equipment and its power supply. A good analysis would have discovered the design deficiency -- no fusing of the buffer amplifier card rack -- and corrected it ahead of time. With proper fusing, the short on the NNI bus would not have occurred, nor would the ensuing Crystal River transient.

V. CONCLUSION

We have concluded that the overall net impact of the approximately 80 post-TMI NRC requirements was definitely positive. The most important improvements are those which deal with the operator.

Our review found that the post TMI-2 requirements of licensees in the areas of operator training, qualification, and improved procedures were of material assistance in managing the reactor during the Crystal River transient and bringing it to a safe shutdown condition. Many of the new NRC requirements for added instrumentation and hardware changes did not contribute significantly to the manageability of the Crystal River transient because either the new instrumentation which would have been important in a more severe accident was not called upon due to successful operator actions at the outset or equipment which could have been useful had not yet been installed.

Our review of the Crystal river transient indicates to us that additional improvements are needed in several areas:

-- A project-type organization should be considered for coordinating and issuing NRC requirements. This would be an individual or organization who would be completely familiar with the status of a reactor. If the project manager were also organizationally or functionally connected with regional office staff, then there would be greater likelihood that the NRC would speak with one voice to each licensee.

-- Routine challenges to reactor safety systems should be avoided. Challenges to reactor safety systems should be used as a last line of defense rather than for routine transient control.

-- More realistic implementation schedules should be established for new requirements. The Commission should instruct the staff to set implementation schedules which allow licensees as well as the NRC staff sufficient time for in-depth engineering evaluation and design, procurement of high quality equipment and its proper installation.

-- Staff and industry should conduct further studies on the use of safety-grade versus non-safety-grade equipment. The initiating event at Crystal River may have been avoided if a proper Failure Modes and Effects Analysis had been performed on the installation of the saturation meter and its associated power supply.

-- NRC needs to make greater use of systems engineering techniques, probabilistic analyses, event trees/fault tree methodology, and less use of deterministic methods. Also NRC requirements should be functional rather than prescriptive.

Attachments:
As stated

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APPENDIX A: POST-TMI-2 REQUIREMENTS

This appendix presents a comprehensive listing of post-TMI-2 NRC requirements in summary form. This summary was drawn from the work of several independent groups which had the responsibility after the TMI-2 accident for analysis and development of these new requirements. Source documents include the reports of the Bulletins and Orders and the Short Term Lessons Learned Task Forces as well as various letters of the Office of Nuclear Reactor Regulation. For each new NRC requirement, an implementation status at the Crystal River plant as of the February 26 transient and a short impact statement are presented. The assessment of impact was made after discussion with NRC staff in the Offices of Inspection and Enforcement and Nuclear Reactor Regulation and industry representatives. The organization of the Appendix is as follows:

Section I: TMI-2 Lessons Learned Task Force (NUREG-0578, 7/79)

Section II: Report of the Bulletins and Orders Task Force (NUREG-0645; Volumes I and II; 1/80)

Section III: IE Bulletins Relating to TMI-2

Section IV: Generic Evaluation of Small Break Loss of Coolant Accident Behavior in B&W Designed 177-FA Operating Plant (NUREG-0565, 1/80)

Section V: Letter of September 13, 1979 from D. G. Eisenhut to All Operating Nuclear Power Plants

Section VI: Letters of September 28, 1979, and January 9, 1980 from R. W. Reid (NRR) to B&W Licensees

I. SOURCE: TMI-2 LESSONS LEARNED TASK FORCE (NUREG-0578, 7/79)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
1. Provide redundant emergency power for the minimum number of pressurizer heaters required to maintain natural circulation assuming loss of offsite power. (2.1.1)	1/1/80	Yes per original design.	No impact; because emergency power not called upon in Crystal River transient.
2. Provide emergency power to power operated relief valves (PORVs) and associated block valves. (2.1.1)	1/1/80	Yes per original design.	Same as 1.
3. Provide emergency power to the pressurizer level indication instrument channels. (2.1.1)	1/1/80	Yes per original design.	Same as 1.
4. Perform prototypical testing for all relief and safety valves. (2.1.2)			
a. Provide program and schedule.	1/1/80	Yes	Valves lifted prematurely (roughly 100 psi lower) during Crystal River transient, but no effect on the course of the transient.
b. Complete testing.	7/1/81	Testing won't be complete for a year.	
5. Provide in the control room either direct position indication of PORVs and safety valves or reliable flow indication downstream of these valves. (2.1.3a)	1/1/80 (Extension granted to 6/1/80.)	Instrumentation not in place.	Ultrasonic sensors in process of being installed -- would have had a positive effect during the transient.
6. Develop procedures to recognize inadequate core cooling with currently available instrumentation. (2.1.3b)	1/1/80	Procedures in place.	Positive impact, increased operator competence and awareness. Recognition portion beneficial.
7. Install a primary coolant saturation meter. (2.1.3b)	1/1/80	Yes (On 2/15/80 in temporary cabinets)	Positive impact. Operators did rely on one of these saturation meters. (Note, however, that on saturation meter had not been functioning properly following installation and ultimately developed a short circuit which initiated the Crystal River transient.)

I. SOURCE: TMI-2 LESSONS LEARNED TASK FORCE (NUREG-0578, 7/79)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
8. Design additional instrumentation and procedures for easy interpretation of inadequate core cooling. (2.1.3b)	1/1/80	Procedures in place for existing instrumentation; but only some new instrumentation had been installed.	Positive impact but additional new instrumentation might have shortened event significantly.
9. Install additional core cooling instru-	1/1/80	Not all new instrumentation installed.	Same as item I.8.
10. Provide containment isolation (diverse signals. (2.1.4)	1/1/80 (Extension to 4/14/80 outage granted.)	No but dedicated operator as interim measure.	Positive impact. Containment isolated by dedicated operator within 4 minutes into the transient sequence.
11. Review and revise as necessary containment isolation provisions for non-essential systems and the potential for inadvertent reopening upon reset of the isolation signal. (2.1.4)	1/1/80 (Extension to 4/14/80 outage granted.)	Will be completed during this outage.	If completed, would have released the dedicated operator for other duties during the transient. (Note design reviews have shown some isolated systems would reopen upon reset.)
12. Provide dedicated containment recombiner penetrations and isolation systems that meet the redundancy and single failure requirements of Commission regulations. (2.1.5a)			
a. Submit description and schedule to NRC.	1/1/80	Action completed.	No impact since hydrogen was not generated during the Crystal River transient. (Note containment purge is the primary means of hydrogen control at Crystal River.)
b. Complete installation.	1/1/81	Not completed as of 2/26.	
13. Review shielding requirements and procedures relating to recombiner use and upgrade. (2.1.5c)	1/1/80	Review completed.	Same as item 12.

I. SOURCE: TMI-2 LESSONS LEARNED TASK FORCE (NUREG-0578, 7/79)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
14. Implement a program to reduce leakage or potential for leakage from systems that would or could carry radioactivity following a transient. (2.1.6a)	1/1/80	Extending and formalizing the existing program.	No impact during transient, no fuel failure occurred.
15. Establish a preventive maintenance program to reduce leakage. (2.1.6a)	1/1/80	Preventive maintenance program established.	No impact since preventive maintenance programs were already in effect.
16. Perform a review of plant shielding requirements assuming accident conditions. (2.1.6b)			
a. Complete review.	1/1/80	Yes	No impact since no fuel failure occurred during transient.
b. Complete necessary changes.	1/1/81	Future implementation.	
17. Auxiliary feedwater design shall be upgraded, if necessary, to provide automatic initiation. (2.1.7a) (Subsequently excluded from Lessons Learned requirements.)			
a. Complete per control grade.	1/1/80	Yes	NRC required automatic initiation signal failed to function due to failed instrumentation (attributable to power supply failure). Consequence was dry out of one steam generator. Auxiliary feedwater supply started manually about 9.5 minutes into transient.
b. Complete and upgraded to safety grade requirements.	1/1/81	Future implementation.	If safety grade automatic auxiliary feedwater initiation in place, would have prevented dry out of steam generator.
18. Provide safety-grade indication in the control room of auxiliary feedwater flow for each steam generator. (2.1.7b)			
a. Complete per control grade.	1/1/80 (Exception to 6/1/80)	Completed.	Positive effect because operator was able to verify auxiliary feedwater flow to steam generator.

I. SOURCE: TMI-2 LESSONS LEARNED TASK FORCE
(NUREG-0578, 7/79)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
18. b. Complete to safety-grade.	1/1/81	Installation to safety grade is a future item.	Same as item I.18.a (if completed) because would have removed single failure possibility.
19. Review and upgrade capability to obtain and analyze samples from the reactor coolant system and the containment atmosphere under high radioactivity conditions. *2.1.8a)			
a. Review complete.	1/1/80	Yes	No impact since no major radioactivity release in Crystal River transient.
b. Procedures for sample collection and analysis complete.	1/1/80 (Exception to 4/1/80)	No	
c. Description of plant modifications.	1/1/80	Yes	
d. Plant modifications complete.	1/1/81	Future action.	
20. Provide high range radiation monitors in containment. (2.1.8b)	1/1/81	Future implementation.	Sames as item 19.
21. Provide high range instrumentation to measure noble gases in effluents. (2.1.8b)			
a. Develop interim measures to allow quantification of release rates up to 10,000 Ci/sec.	1/1/80	Yes	Same as item 19.
b. Complete installation of monitors.	12/1/81	Future implementation.	
22. Provide system description and procedures for quantifying iodine gaseous effluent levels. (2.1.8b)	1/1/80	Yes	No impact since no major release of iodine occurred during Crystal River transient.
23. Implement program to quantify iodine in gaseous effluents. (2.1.8b)	1/1/81	Future implementation.	Same as item 22.

I. SOURCE: TMI-2 LESSONS LEARNED TASK FORCE
(NUREG-0578, 7/79)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
24. Provide equipment and associated training and procedures for accurately determining airborne iodine concentrations inside the plant where personnel may be present during an accident. (2.1.8c)	1/1/80 (Exception to 5/1/80)	Actions complete (check).	Slightly positive impact. Provided operators at Crystal River with confidence that iodine was not being released inside the plant.
25. Provide accident analyses, and upgrade emergency procedures and training as needed. (2.1.9)	Staggered schedule identified in NUREG-0578)	Analysis completed.	Provided substantial positive impact. Operators had effective procedures for maintaining core cooling despite loss of control room instrument indications.
26. Provide a continuous containment pressure indication in the control room. (2.1.9)	1/1/81	In place.	Helpful to operators but a source of some NRC confusion.
27. Provide a continuous containment water level indication in the control room. (2.1.9)	1/1/81	Installation in about one year.	Would have helped if installed by providing indication of containment water level -- especially relevant to the possibility of water covering electrical components and/or machinery.
28. Provide a continuous indication of containment hydrogen concentration to the control room. (2.1.9)	1/1/81	Future implementation.	No impact since hydrogen not generated during Crystal River transient.
29. Provide high point vents, remotely operable from the control room, in the reactor coolant system and reactor vessel. (2.1.9)			
a. Complete design.	1/1/80	Florida Power design not yet accepted by NRC staff.	No impact because reactor coolant system did not reach saturated conditions. (Note: industry representatives does not agree that vents should be placed in the reactor vessel head.)
b. Complete installation.	1/1/81		

I. SOURCE: TMI-2 LESSONS LEARNED TASK FORCE (NUREG-0578, 7/79)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
30. Reemphasize responsibility of shift supervisor for safe operation of the plant and clearly establish his command duties. (2.2.1a)	1/1/80	Yes	Positive impact; emphasize key decision-making role of the shift supervisor.
31. Provide an on-shift technical advisor. (2.1.2b)			
a. Advisor on duty.	1/1/80	Yes	Positive impact. Technical advisor provided useful information to operating staff during the transient.
b. Advisor training complete.	1/1/81	Future implementation.	
32. Review and revise shift turnover procedures. (2.2.1c)	1/1/80	In place.	Positive effects due to better awareness of plant status at the beginning of the transient.
33. Make and implement provisions for limiting access to the control room to those persons responsible for the direct operation of the plant. (2.2.2a)	1/1/80	In place.	NRC requirement not fully followed. Too many personnel in control room for effective management of transient.
34. Set up and maintain an on-site technical support center. (2.2.2b)			
a. Establish center.	1/1/80	Completed.	Limited effectiveness during transient because at this time insufficient information available in Technical Support Center on which to provide effective to control room personnel.
b. Upgrade to meet all requirements.	1/1/81	Future implementation.	Did provide benefit of a "focal" point for NRC and licensee outside the control room for outside communications.
35. Establish an on-site operational support center, separate from the control room, to which operations support personnel will report in an emergency. (2.2.2c)	1/1/80	In place.	Positive impact. Established outside the control room a place where various support personnel should report.

II. SOURCE: REPORT OF THE BULLETINS AND ORDERS TASK FORCE
(NUREG-0645, VOLS. I AND II, 1/80)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
1. Develop and implement procedures for initiating and controlling emergency feedwater independent of the Integrated Control System. (See I.17)	For items 1,2,3, 4, and 5 of II: Crystal River and other B&W plants were shutdown by Commission order of April 79. Completion of these items was required prior to restart. Completion was accomplished by summer 79.	Procedures in place.	NRC requirement may not have gone for enough to assure emergency feedwater to steam generators. Existing requirement had positive effect in that operator had the ability to control water level in the steam generator independently of ICS. But this capability overrides by the automatic steam break isolation system during the Crystal River transient.
2. Upgrade the timeliness and reliability of elivery from the emergency feewater system.			All upgrades to improve timeliness and reliability of auxiliary feedwater supply were in place.
a. Provide for starting of motor-driven emergency feedwater pumps from a vital bus.			No impact on plant operation during this transient since no loss of non-vital auxiliary feedwater buses.
b. Station an operator at local valves during testing in communications with control room.			No impact since transient did not occur during testing of auxiliary feedwater valves and piping.
c. Verify emergency feedwater pumps are operable.			Potential positive impact since auxiliary feedwater pumps were required during the transient.
d. Provide for obtaining alternate sources of water for emergency feed.			No impact since alternate sources of water for auxiliary feedwater were not required during the transient.
e. Provide for automatic start of motor driven auxiliary feedwater pumps.			No impact, since operators initiated motor driven auxiliary feedwater pumps manually.
f. Provide for timely operator notification of emergency feedwater automatic initiation.			No impact, same as item 2.e above.
g. Verify failure position of emergency feed flow control valves.			Potential positive impact verified open at Crystal River.
h. Remove interlock which prevents turbine driven pump from injecting when motor driven pump is operating.			Potential positive impact since operators initiated both motor and steam drive emergency pumps simultaneously. But (as in II.1) this capability was overriden by the automatic steam break isolation system during the Crystal River transient.

II. SOURCE: REPORT OF THE BULLETINS AND ORDERS TASK FORCE
(NUREG-0645, VOLS. I AND II, 1/80)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
3. Implement a hard-wired reactor trip actuated on loss of main feedwater and/or turbine trip.	See item 1.		Control grade installation completed. (Note industry representatives feel that tripping the reactor following a turbine trip is not desirable.)
a. Complete control grade.			Control grade installation completed. No impact since reactor trip was caused by high reactor coolant system pressure.
b. Complete safety-grade.		Future implementation.	Not applicable.
4. Complete analyses for potential small breaks and develop and implement operating instructions to define operator action. (See 1.25)	See item 1.	Revised procedures in place.	Positive impact since revised procedures based upon small break analyses provided operators with effective means for managing the transient (i.e., keep on the HPI pumps).
5. Complete TMI Unit 2 training, at the B&W simulator, for all licensed reactor operators.	See item 1.	Completed.	Positive impact; increase operator awareness of importance of maintenance of adequate core cooling.
6. Make modifications to provide control room verification of emergency feedwater flow to each steam generator. (See 1.18)	Longer term implementation schedule: probably 1/1/81 for items 6, 7, 8, and 9.	Installation of control grade modifications completed.	Positive effect. Allowed operator to verify auxiliary feedwater flow to steam generators.
7. Submit a failure mode and effect analysis of the Integrated Control System.		Analysis by B&W completed.	No impact since NRC review and potential follow-up requirements have not been completed.
8. Continue reactor operator training and drilling of response procedures.		Actions completed	Positive effect -- with operator training modified as a result of the TMI accident.
9. Develop and submit Technical Specifications for Limiting Conditions of Operation appropriate to the above requirements.		Technical specifications were not	NRC licensing has not yet completed its review of revised technical specifications (e.g., no technical specifications in place now for auxiliary feedwater flow indicators; turbine trip; reactor trip; steam generator level initiated reactor trip; and auxiliary feedwater automatic start as a result without surveillance requirement, operability of foregoing cannot be assured).

III. SOURCE: IE BULLETINS RELATING TO TMI-2

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
Review TMI-2 Preliminary Notification (PNs) and detailed chronology of TMI-2 accident. 79-05, 79-05A (Item 1)	4/11/79	Yes	Positive impact since preliminary notification following TMI-2 alerted other B&W plant operators to the potential for TMI-2 type small break loss-of-coolant accidents.
Review transients similar to TMI-2 that have occurred at B&W facilities and review the evaluation of the 11/29/77 transient at Davis-Besse 1. 79-05, 79-05A (Item 2)	4/11/79	Yes	Positive impact, same as item III.1.
Review operating procedures for recognizing, preventing, and mitigating void formation during transients and accidents. 79-05, 79-05A (Item 3)	4/11/79	Yes	Positive impact; new procedures were relied upon.
Review operating procedures and training instructions to ensure that:			
a. Operators do not override engineered safety features actions unless continued operation will result in unsafe plant conditions. 79-05 (Item 4), 79-05A (Item 4a), 79-05B (Item 2)	4/11/79	Yes	Positive impact; HPI automatic initiation was not interfered with at Crystal River. HPI was continued at all times during the loss-of-instrumentation period of the transient.
b. HPI system remains in operation (if actuated automatically) unless:			
(1) Both LPI pumps are operating at a flow rate greater than 1000 GPM and the situation has been stable for 20 minutes, or			Positive impact; same as item III.4.a.
(2) HPI has been in operation for 20 mins. and the RCS is at least 50°F subcooled. 79-05A (Item 4b), 79-05B (Item 2) (Note, 20 minute HPI requirement initially suggested by B&W later dropped.)	4/11/79	Yes	Positive impact operators throttled HPI after regaining instrumentation which allowed subcooling determinations to be made.

III. SOURCE: IE BULLETINS RELATING TO TMI-2

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
c. Until automatic RCP trip is installed and operational: (1) Upon reactor trip and HPI initiation caused by low RCS pressure, trip all operating RCPs, and (2) Provide two operators in the CR at all times to accomplish RCP trip and other required items. 79-05A (Item 4c), 79-05C (Short-term Item 1a and 1b)	7/28/79	Yes	Performed action as required. RCP's were tripped manually upon HPI initiation. Unclear whether impact was positive, negligible or negative.
d. Operators are provided with additional information and guidance not to rely on pressurizer level indication alone in evaluating plant conditions. 79-05A (Item 4d)	4/11/79	Yes	Positive impact; provided effective guidance to operators on evaluating plant conditions.
5. Review all safety related valve positions and positioning requirements and positive controls and all related test and maitenance procedures to assure proper ESF functioning, if required. Verify all AFW valves are in the open position. 79-05 (Item 5), 79-05A (Item 5)	4/11/79	Yes	Potential positive impact; since engineered safety features were required during the transient.
6. Review operating modes and procedures for all systems designed to transfer potentially radioactive gases and liquids out of containment to assure the undesired pumping of radioactive gases or liquids will not occur inadvertently. Ensure that this does not happen on ESF reset. List all such systems and list:	4/16/79 (Exception to 3/31/80 granted)	Reviews not completed.	Positive impact in that these procedures assured that the containment was isolated during the transient. Also provided increased operator awareness of these systems.

III. SOURCE: IE BULLETINS RELATING TO TMI-2

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
a. whether interlocks exist to prevent transfer on high radiation, and			
b. whether such systems are isolated by containment isolation signals. 79-05 (Item 6), 79-05A (Item 9)			
7. Review containment isolation design and procedures and make necessary changes to assure that all lines whose isolation does not degrade core cooling capability will isolate upon initiation of safety injection (HPI). 79-05 (Item 7)	4/16/79 (Exception to 3/31/80 granted)	Action not completed.	Although automatic function not installed, isolation during the transient was achieved effectively and accomplished via manual action from a dedicated operator.
8. Review prompt reporting procedures to assure that the NRC is notified within one hour from the time the reactor is not in a controlled or expected condition of operation. Maintain continuous communication channel. 79-05 (Item 7), 79-05A (Item 12), 79-05B (Item 6)	5/8/79	New reporting procedures in place.	No significant impact on management of the transient. May have had a positive public relations impact.
9. Implement positive position controls on manual valves and manually-operated, motor-driven valves that could compromise or defeat AFW flow. 79-05A (Item 7)	4/11/79	Yes	Potential positive impact since auxiliary feedwater was required during the Crystal River transient.
10. Prepare and implement procedures which assure at least two 100 percent capacity AFW flow paths are available whenever the primary heat removal source is through the OTSG. Implement the following LCOs: If two paths are not available, shutdown within 72 hours and be cooled down within 12 hours. If at least one path is not available, be subcritical within one hour and be cooled down within 12 hours (or the maximum safe rate). 79-05a (Item 8)	4/16/79 (Exception to 3/31/80 granted)		No impact on this transient because the Crystal River plant had no inoperable auxiliary feedwater components at that time.

III. SOURCE: IE BULLETINS RELATING TO TMI-2

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
11. Review and modify procedures for removing safety-related systems from service (and restoring to service) for maintenance and testing to assure operability status is verified and known. 79-05a (Item 10)	4/16/79 (Exception to 3/31/80 granted)	In place. Double verification at Crystal River.	Potentially positive impact in that this requirement assured availability of engineered safety features some of which called upon during the transient.
12. Assure all operating and maintenance personnel are aware of the seriousness and consequences of the simultaneous blocking of both AFW trains and the other actions taken during the early phases of the TMI-2 accident. 79-05A (Item 11)	4/16/79	Yes	Potentially positive impact; same as item III.1.
13. Develop procedures and train operators on methods of establishing natural circulation. Include: means of monitoring efficiency by available instrumentation; assure RCS is at least 50 F subcooled; precautions for pressurizer level indication, pressure control, P-T limits; and procedures in the event of LOFW while in natural circulation. 79-05B (Item 11)	5/8/79	Training accomplished; procedures in place.	Potential positive impact; natural circulation established and verified during the transient by utilizing these procedures.
14. Modify design and procedures which reduce the likelihood of automatic PORV lifting during anticipated transients. Lower high pressure reactor trip setpoint. 79-05B (Item 3)	4/23/79	Modification of design and procedures was complete.	Difficult to judge impact in that PORV failed open. PORV setpoint changed from 2255 to 2450 psig (DB-1 setpoint 2400) High pressure trip setpoint changed from 2355 to 2300 psig.
15. Provide a manual trip (procedures and training) for the following high pressure transients:	5/8/79	Manual trip provided.	No impact, since reactor tripped automatically on high RCS pressure (2300 psi).

III. SOURCE: IE BULLETINS RELATING TO TMI-2

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
a. Loss of Main Feedwater b. Turbine Trip c. Main Steam Isolation Valve Closure d. Loss of Offsite Power e. Low Steam Generator Level and f. Low Pressurizer Level			(Note - industry representatives feel that reactor trips on turbine trip and low pressurizer level are not desirable.)
16. Provide design review and schedule for implementation of a safety-grade reactor trip upon: a. Loss of Feedwater b. Turbine Trip c. Significant Reduction in Steam Generator Level 79-05B (Item 5)	5/23/79	Design review completed and schedule submitted.	No impact on this transient, however, requirement may not go far enough to assure a positive effect during anticipated transients. (Note: Key element is signal selection.)
17. Propose changes to Technical Specifications which must be modified as a result of implementing IE Bulletin items. 79-05B (Item 7)	5/23/79 (Exception to 3/31/80 granted)		No impact since technical specification changes were not in place.
18. Perform and submit a report of LOCA analysis for a range of small break sizes and a range of time lapses between reactor trip and RCP trip. Determine primary coolant temperature and identify any area where primary coolant temperature is greater than 2200 F. 79-05C (Short-term Item 3)	8/28/79	Report of LOCA analysis submitted and documented in NUREG-0623.	Positive impact.
19. Based upon the analyses done in requirement 18 above, develop new guidelines for operator action for both LOCA and non-LOCA events that take into account the effect of RCP trip. 79-05C (Short-term Item 3).	8/28/79	New guidelines developed.	Impact unknown; further analyses should provide relevant information upon which procedures for transient mitigation could be based.

III. SOURCE: IE BULLETINS RELATING TO TMI-2

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
0. Based upon guidelines developed in requirement 19 above, revise emergency procedures and train all operators. 79-05C (Short-term Item 4)	9/12/79	New guidelines developed.	Positive impact; no small break during this transient, however, new guidelines did provide operators with effective procedures for controlling this transient.
1. Provide analyses and develop guidelines and procedures for inadequate core cooling. Define RCP restart criteria. 79-05C (Short-term Item 5)	8/28/79	New procedures for handling inadequate core cooling in place. (Note: Updated version of requirement listed in item III.19.)	Procedures had a positive impact in that they assured adequate core cooling. (Note: Reactor coolant pump restart criteria not yet classified.)
2. Propose and submit a design which will assure automatic tripping of the RCPs under all circumstances in which this action may be required. 79-05C (Long-term Item 1)		Not yet implemented. Operators instructed to perform trip manually.	Impact unknown at this time, however, potentially negative impact since there was no small break but tripping the reactor coolant pumps terminated forced core cooling.

IV. SOURCE: GENERIC EVALUATION OF SMALL BREAK LOSS-OF-COOLANT ACCIDENT* BEHAVIOR IN B&W DESIGNED 177-FA OPERATING PLANT (NUREG-0565, 1/80)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
1. Provide a system to cause pressurizer block valves to close at RCS pressures below the PORV open set point.	1/1/81	No yet installed. Under NRC staff review.	No impact since not installed; NRC staff reevaluating its position on the need for this requirement.
2. Revise trip and valve setpoints to assure that the PORV will open in less than 5 percent of all anticipated over-pressure transients.	1/1/81	Action complete.	This requirement had no effect since PORV failed open.
3. Report failures of PORVs and safety valves to reclose (promptly) and challenges to PORVs and safety valves (annually) to the NRC.	4/1/80	Failures presently being reported.	No impact; and NRC staff has not completed analysis of such failures.
4. Submit a report discussing safety valve failure rate in B&W plants.	1/1/81	Action not completed.	Reporting only and no impact.
5. Revise and do[illegible] analysis methods used for small break [illegible].	1/1/82	Same as item IV.4.	No impact.
6. Submit plant-spe[illegible] calculations, using NRC models, for [illegible] breaks to show compliance with [illegible]46.	1/1/82	Same as item IV.4.	No impact.
7. Perform analyses to determine if core flood tank injection models are conservative.	7/1/80	Same as item IV.4.	No impact.
8. Install automatic reactor coolant pump trip activated by small break LOCA.	1/1/81	Same as item IV.4.	No impact.
9. Review and upgrade reliability and redundancy of non-safey grade equipment used in mitigating small break LOCAs.	Action Plan	Same as item IV.4.	No impact.

*Note - although NUREG-0565 has been distributed and in some cases acted upon by B&W owners, it has not been formally issued as a set of requirements i.e., no cover letter to B&W owners has been sent.

IV. SOURCE: GENERIC EVALUATION OF SMALL BREAK LOSS-OF-COOLANT ACCIDENT BEHAVIOR IN B&W DESIGNED 177-FA OPERATING PLANT (NUREG-0565, 1/80)

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
10. Provide SBLOCA simulator training for all operators.	1/1/81	B&W operators have already been required to complete TMI-2 simulator training.	Positive effect.
11. Verify, experimentally, various modes of two-phase natural circulation.	1/1/82	Future implementation.	No impact. (Note: Duke Power, Florida Power and B&W feel this should be done in a scale model experiment and <u>not</u> in a commercial plant.)
12. Install additional control room instrumentation to verify natural circulation.	1/1/81	Same as item IV.11.	No impact.
13. Perform analysis of plant response to a small break which is isolated, causing RCS repressurization and subsequent stuck-open PORV.	6/1/80	Same as item IV.11.	No impact.
14. Perform analyses of plant response to a small break in the pressurizer spray line with a stuck-open spray line isolation valve.	5/1/80	Same as item IV.11.	No impact.
15. Evaluate the effects of water slugs in in piping cased by HPI and core flood tank flows.	5/1/80	Same as item IV.11.	No impact.
16. Provide pretest predictions for LOFT test L3-6 (RCPs running).	Schedule no finalized.	Same as item IV.11.	No impact.
17. Provide both technical justification for omitting radiolytic decomposition of injected ECC water as a source of non-condensible gas; and confirmatory information to verify the predicted condensation heat transfer gradient.	5/1/80	Same as item IV.11.	No impact.

V. SOURCE: LETTER OF 9/13/79 FROM D.G. EISENHUT TO ALL OPERATING NUCLEAR POWER PLANTS

Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
1. Upgrade emergency plans to conform with Regulatory Guide 1.101.	1/1/80	New plans have been submitted, but Crystal River is operating under existing plans.	No impact, because state and county implementation of emergency plans not required during this transient. (Note: closest residence 3 miles from Crystal River.)
2. Establish an Emergency Operations Center for Federal, state and local officials.			
a. Designate location and alternate location and provide communications to the plant.	Mid-1980	Interim emergency center established.	Impact unknown.
b. Upgrade Emergency Operations Center in conjunction with in-plant technical support center. (See I.34)	1/1/81	Not yet completed.	
3. Improve offsite monitoring capability.	Mid-1980	Implementation not complete.	No impact, but implementation would have provided assurance that no off-site releases has taken place.
4. Assure adequacy of state/local plans.			
a. Against current criteria.	Mid-1980	Completed.	Same as item V.1
b. Against upgraded criteria.	1/1/81	Not completed.	No impact.
5. Conduct test exercises.			
a. Test licensees new emergency plans.	Mid-1980	Not completed.	
b. Test states new emergency plans.	Mid-1980	Not completed.	
c. Joint test exercise of new emergency plans (Federal, state, local, licensee).	1/1/81	Not completed.	

VI. SOURCE: LETTERS OF SEPTEMBER 28, 1979, AND JANUARY 9, 1980
FROM R.W. REID (NRR) TO B&W LICENSEES

	Requirement	Implementation Required by	Complete Prior to Crystal River Transient (2/26/80)	Impact on the Crystal River Transient
1.	By analysis and/or experiment, address the mechanical effects of induced slug flow, which may occur during natural circulation/reflux boiling transitions, on steam generator tubes (11/21/79).	6/1/80	Work has been completed.	Results may suggest need for some design changes. No impact.
2.	Evaluate impact of RCP seal damage and leakage due to loss of seal cooling on loss of off-site power (11/21/79).	6/1/80	Evaluation in progress.	Positive effect, caused operating staff to evaluate seal condition prior to restart of reactor coolant pumps.
3.	Evaluate PORV and safety valve lift frequency and increase in reactor trip frequency based on revised PORV and high pressure reactor trip setpoints (9/28/79).	1/1/81	Future analyses.	No impact.
4.	Perform an analysis of potential voiding in the RCS during anticipated transients (1/9/80).	1/1/81	Future analyses.	No impact.

APPENDIX B

Chronology and Comments on the Saturation Meter Installation at Crystal River

The following comments are presented to substantiate the inference that some haste was involved in the installation of the required saturation meter at Crystal River. The schedule below indicates the key dates. The requirements for the meter to be installed by January 1, 1980 was delineated in Mr. Eisenhut's letter of September 13, 1979. Florida Power actions then were:

Purchase Order Issued:	10/30/79
P. O. Acknowledged by B&W:	12/4/79
Equipment Received:	1/24/80
Quality Assurance Documents Received	3/27/80

It is obvious that despite best efforts the January 1, 1980 date could not be met and a waiver was granted by NRC until February 15, 1980 to complete the installation. The best effort apparently required some improvisation at Baily Meter and/or by the technicians at Crystal River. A detailed examination of photographs of the buffer amplifier card that created the transient revealed that it was not identical with the other similar, and supposedly technical, cards in the rack. The following differences were noted:

1. The new buffer printed circuit card base was a punched-out production type card having the same dimensions as the other cards. But the printing process appeared to be different. The previously obtained cards were tinned and connected by what appears to be a production type wave soldering equivalent process. The new buffer card appears to be manufactured by a different process, possibly being hand made in the laboratory.

2. The circuit was slightly different. On the new card, a 200,000-ohm resistor was omitted and previously jumpered wires were now printed connections. The printed wire routine was somewhat different.

3. The principal active element in the circuit (probably an integrated circuit operational amplifier) had its leads soldered to the board in a different and obviously poorer manner. It appeared as though the original circuit element had been removed and replaced by a new one by someone with less skill than the original solderer.

4. No QA stamps were in evidence on the new card, whereas the prior cards were clearly marked by inspectors' stamps. It is doubtful that the poor soldering on the new card would have passed inspection. Note also that QA papers did not arrive at Crystal River until a considerable time after the equipment (and after the incident).

All of the above items may indicate some pressure and haste to get the saturation meter installed, but in all fairness, did not contribute directly to <u>this</u> incident.