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March 30, 1990
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U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Gentlemen:

Three Mile Island Nuclear Station, Unit 1 (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
Power Limitations at TMI-1

This confirms conversations with NRC staff on March 28th and provides the technical basis for our planned actions to correct our present limitation of power due to high steam generator secondary side differential pressure at TMI-1. In summary, we plan to trip the main turbine from about 80 percent power and then, following reactor trip, initiate Emergency Feedwater (EFW), briefly stop and restart all four reactor coolant pumps and vary steam generator water levels using the EFW system. This sequence has been found effective at TMI-1 in correcting abnormally high steam generator water levels. We have prepared a procedure for this evolution based on our previous experience with this transient, and we have verified the post trip plant performance on the TMI-1 plant simulator.

We call your attention to our letter of August 24, 1987 (copy attached) wherein we addressed these same considerations. Our view today is generally consistent with that expressed in that letter. In particular, we believe that a deliberate trip of the plant should not be undertaken except for strong reasons and even then only after careful consideration and under controlled conditions.

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We consider the current TMI operating condition--that is, at 80 percent power limited by high water level in one steam generator--to be one which should be corrected. Among the alternatives available to us, we consider a planned reactor trip to be the one which is technically preferred, both from a standpoint of minimizing stress on the steam generators and offering the greatest likelihood of success. Such a trip is, of course, wholly within the design basis of the plant and will be conducted by a fully qualified and experienced staff.

We believe that continued operation in our current condition is undesirable. This is the plant condition which existed when we sustained the steam generator tube leak on March 6th of this year. We believe that these operating conditions may have contributed to the high cycle fatigue tube failure since it is known that at reduced power the steam generator tube loading results in higher amplitude tube vibration. We also believe it is possible that excessive fouling in the generator can cause localized flow abnormalities which may contribute to vibration induced failure. For these reasons, we conclude that extended operation with fouled generators at reduced power, either for the remainder of the cycle or for an interim period until other corrective actions could be implemented, is not desirable. Rather, we believe that the best and safest course of action is one which alleviates the fouling problem as quickly as practicable, and which permits return to full power operation.

We also note that the alternative of the "water slap" technique, while avoiding the need for reactor trip from power, nonetheless subjects the steam generator and its tubes to a higher loading condition than does our planned shutdown method, and it requires returning the plant to a cold shutdown condition, a process which itself subjects the plant to a fatigue cycle. Furthermore, based on our own experience with the water slap process at TMI-1 and our understanding from others who have used the same method, we would expect it to be less effective than the planned sequence in redistributing secondary side deposit materials.

As we stated in our letter of August 24, 1987, we believe that the long-term corrective action to the problem lies in some combination of secondary side chemistry control and chemical cleaning of the steam generators. During the last operating cycle, we shifted to morpholine secondary side water chemistry . Based on that very successful operating cycle, we concluded that chemical cleaning could and should be deferred, and we did not expect that the previously experienced high steam generator water levels would return. It should be noted that morpholine has not yet been utilized during this current operating cycle. It cannot be used until the new feedwater flow nozzle calibration has been completed or postponed. We are continuing to evaluate the long-term effectiveness of improved secondary side chemistry control.

While we regard chemical cleaning as a likely requirement sometime in the future, we note that such a course should be taken only with the greatest care and deliberation. Other plants' experience with chemical cleaning has not been entirely satisfactory, and the potential for introducing long-term sources of material degradation through chemical cleaning leads us to move in that direction with caution. We have been actively investigating chemical cleaning options for several years and have a materials test program underway. We would expect to implement this step once the process is fully qualified for TMI-1 and we are satisfied that it is a necessary and technically appropriate action.

We suggest continued interaction among our staffs on these issues. At your convenience, we can meet with you to share the technical information we've developed on all aspects of the causes and corrections to steam generator fouling, and we will keep you apprised of our progress in assessing chemical cleaning options. We will also continue to advise you in advance of our plans.

In summary, we believe that unnecessary plant transients and challenges to reactor safety systems should be avoided, but we have concluded that under present circumstances the planned trip is the best course of action. The procedure will be conducted under carefully controlled conditions by a fully qualified staff. We expect NRC representatives will observe as well. We believe this is a prudent course of action, all things considered, and we plan to proceed on this basis.

Very truly yours,

J. C. DeVine, Jr.
Director, Technical Functions

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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Three Mile Island Nuclear Station, Unit 1 (TMI-1)
Operating License No. DPR-50
Docket No. 50-289
OTSG Fouling - Long Term Plan

TMI-1 has experienced power output limitations due to secondary side fouling of the Once Through Steam Generators. This letter briefly reviews prior GPUN actions on this problem and describes our planning for future remedial action should such generator fouling again inhibit power output.

As background information, Once Through Steam Generator fouling experienced at TMI is not unique but has occurred at a number of plants with B&W nuclear steam supply systems and Once Through Steam Generators. The fouling is believed to be caused by the deposition of metal oxides in the boiling region of the steam generator. These metal oxides are introduced into the generator principally via the feedwater system. The magnitude of the metal oxides introduction is a function of the oxygen content of the feedwater, water pH, overall water chemistry, and operation of the secondary side plant drain systems. Substantial effort has been made at TMI to minimize the introduction of these materials into the steam generator. Once introduced, the metal oxide can deposit in the generator either on the tubes or other surfaces, including directly in the broached holes in the tube support plates. For material deposited directly in the broached hole, it will act to reduce the water/steam flow area and thereby directly increase generator pressure drop. For material deposited on the tubes, that material, after building to sufficient thickness and subjected to thermal cycles (for example, normal shutdown), can spall from the tubes in the form of loose flakes. This spalled material can be suspended on the underside of tube support plates during operation, also blocking water and steam flow passages and increasing system pressure drop. This latter form of increased pressure drop predominates at TMI-1 as determined by direct inspections approximately a year and a half ago. With sufficient increase in the secondary side water/steam pressure drop, the water level in the Once Through Steam Generator

downcomer increases to compensate until such time as the level reaches a minimum level below the main feedwater nozzles. If that should happen, feedwater heating is severely reduced and instabilities can occur. This condition is an unacceptable operating point for the generator. Water level in the downcomer can then only be reduced by either reducing the obstructions caused by debris or reducing steam and feedwater flow rate.

The first time a power limitation was observed at TMI was late 1985. Subsequently, as part of the Power Escalation Test Program, a turbine reactor trip was performed. When the plant was restarted, steam generator level was low enough to achieve full power operation. The second time a power limitation was experienced was early in 1987 at which time the plant was limited to about 83% power level. When the power level limitation was observed, GPUN evaluated all of the available options to determine if near term corrective action could be taken. These options included techniques for trying to redistribute the particulate matter at power by introducing small pressure fluctuations in the generator through turbine throttle/bypass valve operation, deliberate power ramp downs followed by power increases, planned reactor shutdown, and a process referred to as "water slap," performed while the plant is shut down. Over a period of several weeks the various alternatives were evaluated. Introduction of minor pressure fluctuations and powering the plant down were performed without impact on generator operation. We also initiated work to be prepared for "water slap" should that become necessary. After many detailed reviews, including a specific safety review, a planned automatic reactor shutdown from a manual turbine trip was performed. Upon plant restart, generator levels had recovered to permit 100% power operation with adequate margin. The planned shutdown was performed with a special temporary procedure and existing plant procedures. Additional Operations personnel were assigned during the shutdown, and site and corporate technical support were also present.

In the long term, GPUN is convinced the only technically viable solution to the generator fouling is to continue maintenance of high quality water chemistry coupled with periodic but infrequent chemical cleaning of the secondary side of the steam generator. As of this date, no Once Through Steam Generator has been chemically cleaned, although one plant is scheduled for cleaning in the Fall. In fact, very few nuclear steam generators of any type have been chemically cleaned. GPUN is actively reviewing chemical cleaning options, and we have been instrumental in trying to expedite final EPRI review and qualification of the KWU developed process. Our own assessment of where we are, what data is and will be available in the industry, and the TMI-1 operating cycles suggests the earliest time we could implement such cleaning would be the scheduled 1990 outage. Depending upon the final process selected and the needed facilitation, it is conceivable it could not be ready until the following outage.

Given the unavailability of chemical cleaning in the near term, the only options in the event future steam generator limitations reappear are mechanical "water slap" or techniques which alter water/steam flow paths in the generator such as power transients or the plant trip referred to earlier.

We are continuing to prepare the plant, the procedures, and the operating staff to perform "water slap" should it be required. However, we would also intend to fully reassess technical, operational and safety aspects of all possibilities before any future decisions are made for TMI-1. This would include examination of where the plant was in the operating cycle and other technical trade-offs including the implication of opening the steam generators and subsequently subjecting them to the "water slap" pressure loadings (which have been determined to be greater than those developed by planned manual plant shutdown, although both are well within the Once Through Steam Generator load capabilities).

In summary, GPUN, both independently and in conjunction with others, has and will continue to assess and support evaluations to correct Once Through Steam Generator fouling and do so on a manageable, low risk basis. Ultimately, we are convinced that chemical cleaning will be required and are actively working to support and evaluate final process qualification. Any future near term course of action will be predicated on a careful, thoughtful review of the circumstances at the time. We will keep the Staff fully informed of these ongoing evaluations.

Sincerely,

H. D. Hukill, Jr.
Vice President and Director, TMI-1

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