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APR 12 1984

MEMORANDUM FOR: Frank Rowsome, Assistant Director for Technology, Division of Safety Technology, NRR

FROM: Jerome Saltzman, Assistant Director for State and Licensee Relations, OSP

SUBJECT: REPORT OF THE MICHIGAN PSC STAFF ON FERMI

We have corresponded in recent months on incentive regulation of nuclear generator facilities by PUCs. Further, we noted your trip report highlights (November 8, 1983) on the ANS Winter Meeting. In that report you mention that a number of speakers indicated that "very few utilities are looking beyond mere compliance with safety regulations and conventional maintenance practice to improve either their accident risk profile or to improve their availability."

I thought the pages I have excerpted from a recent Michigan PUC staff report would be of interest to you. In this report* the PUC staff uses such terms as:

> "The owner of a nuclear plant is sufficiently subjected to mandatory regulations and it is not prudent to volunteer compliance when costs are an important concern." (p. 232)
>
> "In principle, safety, public health, and environment are all noble causes and should be protected. In reality, how safe is safe must be determined with a rational decision process. One can quickly get into diminishing returns when striving to achieve incremental safety. Edison Management took the general approach to err on the side of safety." (p. 319)
>
> ". . . the Staff was troubled by the fact that, in many instances, Edison exhibited near-paranoid concern for environment and safety and acted to placate any potential opposition." (p. 500). Emphasis added.

Please let me know if you have any further questions.

/s/ JEROME SALTZMAN

Jerome Saltzman, Assistant Director
State and Licensee Relations
Office of State Programs

Enclosures: Excerpts
from Subject Report

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* "Staff Investigation of Enrico Fermi 2 Nuclear Power Project," prepared for the Michigan Public Service Commission, February 1984

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DATE							4/12/84

STAFF INVESTIGATION OF ENRICO FERMI 2

NUCLEAR POWER PROJECT

Prepared for the

Michigan Public Service Commission

Lansing, Michigan

February 1984

The Staff also reviewed the question of plant rating as a result of the switch from once-thru to closed-cycle. An analysis performed by Edison shows that average derating of only 1% (about 12 MW) is expected to occur as a result of the CT decision. The mechanical draft would have improved it by 1MW. Further, that the largest derating (up to 5%) may occur only on the 3 hottest days in summer when the back pressures may increase to 3½ inches.

Finally, the plant efficiency will decrease by an average of 105 Btu/kWh as a result of CT, with the largest losses experienced in the summer, of up to 200 Btu.

The Staff is generally satisfied with the plant heat rate and derating conclusions. No further disallowance is recommended for these items.

Issue Analysis

There are at least three issues raised by this Edison decision:

(1) Were the cooling towers necessary? Did Edison overreact to the environmental fears?

(2) Were the cooling towers oversized due to design constraints or other reasons?

(3) Should the expenditures on the intake system be disallowed as imprudent, not used and useful?

1. In our judgement, Edison took the line of least resistance with environmentalists, the AEC, and other regulatory groups. This has been generally the Edison philosophy. While concern about possible later problems was legitimate, Edison had no mandatory obligation to switch to

was not until 1975 that EPA mandated cooling towers. Even so, exemptions were granted to units under construction, such as the 2-unit, 1050 MW each, Cook plant, completed in 1977-78 in Michigan. Edison claims that it won the appreciation of the Sierra Club due to the CT decision.

It should be noted that Edison's was one of the earliest cooling towers in the nuclear industry, although it became fairly prevalent later on.

Our opinion is that Edison should have stood firm on their decision once the once-thru system was designed. Although less desirable than CT, there was no serious challenge to it. Further, if challenged, they should have seriously resisted. It is possible that, in the end, Edison had to give in. The erection cost of the cooling towers would not have changed materially in 1975 as compared to 1973-74, when AFUDC is included, nor would it impact the schedule or interfere with other construction.

The owner of a nuclear plant is sufficiently subjected to mandatory regulations and it is not prudent to volunteer compliance when costs are an important concern. A second related question is that if Edison was reconsidering the cooling system in mid-1970, why did it not take a serious look at this option in August 1969--it left the door open for a possible CT, but went forward with the lake intake route. No major events had occurred to alter the situation. NEPA was under consideration in 1969; the Calvert Cliff decision did not come until April 1971.

Our conclusion is that while the cooling tower decision per se is not imprudent, the indecisive manner in which it was finally arrived at was inefficient. The result was that Edison ended up with the most

expensive option, lots of duplication and a significant adverse effect on system output and efficiency.

In the nuclear business, it is dangerous to equivocate.

2. As indicated earlier, the cooling tower design became subject to the constraints of the design parameters of the condensor and turbine, which were already underway. The unit had to be derated due to higher back pressure and lower heat rate efficiency. In 1971, Edison was planning a second nuclear unit at Fermi of the same size, which called for only one CT of 650,000 gpm capacity, i.e., somewhat larger than the ones built for Fermi 2 (450,000 gpm each). This was to be accomplished through a larger Δ and corresponding sizing of turbine and condensors.

We believe, therefore, that the current cooling tower is overbuilt compared to one designed and built ab initio. Therefore, expenditures prorated for only one CT should be allowed, recognizing that there are savings in design and construction of two towers compared to one.

3. Although no major installation work was done on the lake discharge mode, some engineering and bid analysis process was underway. Since Edison changed their decision rather soon, and in view of the discussion in (1) above, we believe that Edison not recover expenditures associated with the lake intake design work and any installation preparation work.

However, in view of the recommendation in (2), we believe disallowance of 50% of entire cost of the cooling tower expenditure would adequately cover item (3) , and no further adjustment is necessary.

Among the most positive accomplishments for which Edison Management; in general, and Mr. Tauber in particular, should be commended is the relationship with the NRC. It is a delicate and most important relationship in a nuclear project. Thus far, Edison has managed it well.

It is our judgement that collectively, Edison's top management has taken serious and deep involvement in the project. All of the executives, however, expressed the feeling that the Project Manager and the PMO were given the widest authority for project conduct. Management claimed a "hands off" policy.

We believe that even though Management had a good grasp of the project, it has, in the large part, been docile. Management, in our opinion, has also allowed outside forces and events to dictate the project. Vendors and contractors took advantage of the Edison Management approach.

Senior Management receives monthly project progress reports and visits the project site every month to receive briefings from the PMO. Informally, there are daily and weekly meetings within the management to resolve problems, and assess options and strategies. The Fermi project has not suffered from lack of management attention. Much of the communication between Senior Management and the PMO was verbal.

3. Management Philosophy

a) Although engineering and technical knowledge of the Edison Management enabled it to play a dominant role in technical decisions, it was not without its side effects. The watchwords

throughout the project were: safety, public health, environmental concerns, and NRC compliance. Edison's own version of project history is replete with phrases such as, "defense in-depth"; "to make an already safe plant safer"; etc. Edison Management expressed near-obsessive concern for these issues. In turn, these have permeated through all major technical decisions. Within two weeks of the TMI accident, Edison instituted a task force to take a comprehensive look at safety issues at Fermi. In principle, safety, public health, and environment are all noble causes and should be protected. In reality, how safe is safe must be determined with a rational decision process. One can quickly get into diminishing returns when striving to achieve incremental safety.

Edison Management took the general approach to err on the side of safety. As the Chairman of the Board expressed it:

> "As an engineer, I view myself with a different perspective on safety".

As the President of the Company admitted, the QA organization has been allowed to drive the project:

> "I have let QA have a free hand, because I have faith in them".

In terms of NRC compliance, the Management has, in general, taken a non-adverserial approach: "better to switch than fight". Of course, this approach, coupled with good relations, has paid off thus far.

It is impossible for us to evaluate the cost-benefit effects of NRC compliance. Admittedly, one can attribute enormous benefits in light of difficulties at Zimmer, Diablo Canyon, and the Midland projects.

We simply surmise that additional costs have been incurred to improve licensability, safety, public concerns, and concomitant benefits derived therefrom.

b) Looking at the technical decisions, one is tempted to observe that it appears to be the Management policy to insulate Fermi 2 from outside forces to the extent possible; in other words, make Fermi a self-contained complex.

Examples supporting this observation are:

- Cooling towers vs. lake discharge
- On-site storage to reduce dependence on low-level waste transportation
- Separate, enclosed RHR Complex vs. an open pond
- Elaborate security system
- Shore protection barrier
- Four emergency diesel generators where two were needed at the time

Many of these were voluntary actions at the time they were taken, and are at variance from industry norms. It should be

noted here that Edison took little advantage of the Fermi 2 location near Lake Erie.

4. Corporate Financial Support, Budgetary Controls, and Surveillance

Fermi 2 is the largest single project undertaken by Detroit Edison. Since the project restarted in February 1977, it has been the top priority project for Edison. It has also been the largest cash drain. Review of annual budgets and expenditures indicates that overall financial support has been adequate for Fermi 2. There have been periods of budget cuts and freezes throughout the project. However, these were in proportion to financial restraints Company-wide. Outside of the shutdown phase 1974-77, which we shall soon discuss, and the freeze in November 1981 prompted by the Supreme Court Case on Securities, the project has received the necessary overall funding.

The annual expenditures steadily increased since 1975 at Fermi. In most years, the actual expenditures exceeded the budget. From time to time, restrictions were imposed on field expenditures. But these, in our judgement, were normal management maneuvers to control field expenses, adjust to revised schedules, etc. For example, as a typical case, the budget for the year 1980 was proposed as $226 million based on requests from each group early in 1979 (before TMI). After the normal management review, and reassessment of TMI effects on schedule date, a $199 million budget was proposed to the Board. This was approved in June 1979. No budget restrictions were imposed.

7. Staff Conclusions

1. The regulatory relationship between the EF2 project and the NRC has been relatively quiet, and in the Staff's opinion, positive. DE corporately advocates a non-adversary approach with the NRC and has taken an aggressive posture with the NRC only on select issues. Given the licensing and enforcement difficulties at other like-vintage plants, this policy, in the Staff's opinion, appears prudent.

2. Regulation growth in the Quality Assurance area was fairly stable. Most changes reflect escalation of enforcement philosophy by the NRC and not regulation growth.

3. Regulation growth in the technical area has been substantial and is ongoing. The Staff did not attempt to evaluate each NRC regulatory guide for specific application to Enrico Fermi 2. Detroit Edison maintains that the cost spiral at EF2 was generated by increased Federal requirements. The Staff identified the existence of these requirements. Questions still remain with respect to certain items whether DE was required to comply or did so by corporate choice. The evaluation of each guide and standard with respect to application to EF2 requires resources beyond those available to the Staff.

4. The Staff did not attempt to evaluate the effectiveness of DE's Quality Assurance Program in constructing a "safe" plant, since this is beyond the jurisdiction of the MPSC.

5. Quality Assurance imposes visible financial and administrative burdens on a project like Enrico Fermi 2. The Staff recognizes

established a cumbersome and arduous paperwork and routing system. Turn-around time on minor engineering items typically ran into weeks - waiting for Troy approval. Later, Edison set up expediting systems such as F.A.S.T. (Field Action Sheet Troy) to monitor the engineering responses and D.C.P. progress meetings.

Finally, the engineering activities and response time suffered due to various outside A/E groups who were remotely located; S & W (hangar design) in Boston; S & L (pipe analysis) in Chicago. All their inputs were to be coordinated by Troy office. Later in 1983, some AE design groups were located at Fermi 2 site. For example, the latest drywell steel modification design is being done by a large crew from S & L, at the site.

During the period of our investigation, Staff met several times with the Director of field engineering, Mr. Dave Spiers. In our opinion, he is well respected, competent and well qualified for the job. In our judgment, he should have been allowed greater authority and responsibility towards the project completion. Attempts to revise procedures granting more flexibility to field staff were turned down by Troy (see DCP weekly notes, February 24, 1983).

2. Role of System Engineering

As had been noted in several places, one of the strengths of Detroit Edison was a highly technical and competent Systems Engineering Group. The project System Engineer is involved in all phases of system development and frequently encounters a wide spectrum of special assignments requiring technical expertise in nuclear power. Above all, he must be able to develop systems and prepare design instruction to assure CAMEOS i.e., constructability, availability, maintainability, economy, operability and safety.

This technical ability facilitated communication with the outside AE groups, upper management and with field construction - although this last one less successfully. Technical competence of the Edison Systems Engineering Group was also commended by other principal AEs and GE Project Managers involved at Fermi 2 and also NRC (see SALP Report 1982).

Concern for safety permeated throughout the general Edison philosophy. As a result, Project Engineering had a tendency to overdesign and err on the side of safety. Some of the examples of this over-cautiousness are:

a. All controls at Fermi 2 are centralized in the main control room. Typically, other nuclear units have dual controls for major systems: the main controls and the local controls. Edison determined that, for safety reasons, no local controls be provided because people walking around the plants may be pushing buttons, etc.

While this decision may improve safety, it caused significant difficulties during the testing phase. In repeated testing process, pumps, motors, and valves had to be opened and closed from the main room requiring additional communication and delays.

Secondly, cable termination and instrumentation had to be completed before a system could be centrally controlled. As we have noted, cable pulling and termination rates were the poorest at EF2. Therefore, in our judgment, the "single control" decision caused testing problems.

b. By design, [illegible] NRC at the time. (See comments by McCarthy, Engg. Committee Meeting, Nov. 1969.) Subsequently, however, the NRC raised the standards to ALARA.

c. Buildings were designed QA1 level when they didn't have to be; for example, RHR and auxiliary buildings. Similarly, higher than required Q-levels were used for piping design in the turbine building. As has been noted, all cables at EF2 were QA1 level.

d. FSAR prepared by Edison in 1973-74 was too detailed and included many non-safety items and informational items. Also, specifications were lifted from vendor catalogue (e.g., HVAC Systems) and not carefully reviewed. Edison engineers did not fully realize the importance of commitments in the FSAR, or were overcautious. Now NRC considers FSAR a binding document. FSAR should only have included safety items. As a result, NRC holds Edison accountable for everything specified in the FSAR, which is a lot more than required. Also, Edison has boxed itself in by specifying higher test standards than necessary. NRC holds them to these commitments. The situation has led to some testing problems. In their 1983 SALP report (Pre-op testing was ranked "3" i.e., poor), NRC raised these issues with the Fermi Management. We discussed the issue with the PM who admitted some problems. FSAR is being upgraded or re-written (FSAR must be completed and approved prior to the fuel load). As an example:

- The initial FSAR specified that the reactor building overhead crane (used for fuel rod movement) shall be inspected/maintained once a year (per ANSI standards). Since fuel reload will be required every 18 months, Edison now feels that annual crane inspection (which is quite a costly and cumbersome procedure) is unnecessary. The FSAR was re-written to specify that the crane will be inspected prior to each reload, and if required for any other purpose, it will be ensured that inspection has taken place within the previous twelve months.
- FSAR specified clean steam testing of the HPCI, RCIC and the main turbine. The last one is a non-safety system and doesn't belong in FSAR. Some engineers at Edison feel that it is an NRC commitment.
- In the 1983 SALP report, NRC noted deficiencies in the Pre-op testing because test results did not match the higher FSAR performance criteria as in the case of power supply and battery systems (already turned over to NUC OPS). It should be noted that a significant portion of EF2 FSAR came out of GE specifications. GE also reviews many test specs and test results on safety systems.

Overall, Staff believes that the System Engineering Group for Fermi 2 has been the backbone of Project Engineering Organization. The group has technically capable people who understand nuclear systems and can interact with NRC and AE groups. In our judgment, existence of this

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Overall, Staff believes that the System Engineering Group for Fermi 2 has been the backbone of Project Engineering Organization. The group has technically capable people who understand nuclear systems and can interact with NRC and AE groups. In our judgment, existence of this

group preserved the project during shutdown and prevented its disintegration. One disadvantage of competent engineering group was that they always strived for perfection and continual improvements at the expense of target schedules. Engineers have to learn to quit fiddling.

3. Project Design Group

Performance of design groups (both in-house and out-of-house AE's) has been the single-most failure in the Fermi 2 project. Several factors contributed to this performance, including:

- organizational and internal problems.
- gross underestimation of detail design efforts from the inception of project
- excessive redesign of systems
- poor control and supervision of design efforts and lack of coordination between several speciality AE's and DECo; overfragmentation between disciplines
- excessive turnover of qualified design engineers over the project history.

As has been noted, Edison paid scant attention and importance to the detail design effort necessary in a nuclear project. At first, Edison felt confident that it could handle most of the detail design work in-house with some outside help. Pretty soon it discovered that, not only could it not meet the project schedules, but the quality of design work was deficient. As we have discussed in the case of the radwaste system, south pump house and general service water, the systems were poorly designed for both operability and maintainability. Costly modifications had to be made later to correct deficient design. Careless design of systems shows hundreds of elementary mistakes such as:

engineering personnel with nuclear experience seriously impacted the progress. Turnover was a serious problem in this area during much of the project.

Simultaneous work on EF3 PSAR in 1972-73 further taxed the technical resources.

2. Environmental and Safety Concerns

Safety and environmental concerns were paramount to the Edison management throughout the Fermi project. Compliance in many cases was voluntary (e.g., cooling towers) beyond the regulatory requirements and in some cases, pre-emptive. Staff findings are mixed on this issue.

On the one hand, Edison exhibited good judgement, responsible corporate attitude and respect for public concerns. These paid off throughout the project in terms of public understanding, intervencr opposition and local and state support for the project. The importance of this to the project, Edison, and ultimately to the ratepayers, should not be minimized. On many issues, Edison came out ahead because of their anticipatory actions.

On the other hand, the Staff was troubled by the fact that, in many instances, Edison exhibited near-paranoid concern for environment and safety and acted to placate any potential opposition. The Staff is left with the impression that Edison was attempting to build a self-contained, self-sufficient complex insulated from outside environment, elements and forces. Numerous examples of these were found: on-site storage, RHR building, shore barrier protection, and cooling towers.

3. Relationship with the Nuclear Regulatory Commission

Because of the management philosophy on safety issues as described above, there was inherent respect for the nuclear regulatory process. Management directives attached great importance to regulatory compliance and a non-adversial relationship to the regulators. This went beyond lip service or good public relations into substantive matters. Sincerity of purpose and mutual responsibility was recognized. As a result, one of the major success stories at EF2 was its NRC relationship and record. The importance of this has been brought home by a recent rash of QA-related nuclear disasters. Edison should be commended for their efforts in this area.

4. Project Construction

a. In general, the construction progress has been at the mercy of engineering, material procurement and quality control inspection functions.

b. The construction management organization has generally performed well and been staffed with competent people. One criticism in this respect is the fact that Edison tends to move their people around too often, both within the project and across projects. Second, (and this is a generic problem with the Edison organization), management tends to over-protect its own people. Even when significant performance deficiencies were found, management took benign action. This will be further discussed later.

C. A Final Word

By design, this investigation highlights only the weaknesses of the Fermi 2 project management. It deserves mention here that throughout the project we noted numerous examples of superior performance, good judgement and responsible management. These have received inadequate attention in our report.

As we mentioned in the beginning of this report, constructing a nuclear plant is a complex, massive undertaking. It calls for a long sustained commitment by the utility - commitment both in skilled manpower and financial resources. The construction of nuclear projects has become particularly agonizing due to increasing public pressures, regulations and safety concerns. Fermi 2 is a far cry from the project that Edison set out to build in 1968.

The management has faced thousands of issues, dilemmas and decisions. In the main, we believe they have been resolved in a reasonable and prudent manner, notwithstanding all the questions raised in the body of this report.

A positive characteristic of Edison Management is that it was never afraid of self-evaluation and self-criticism in order to improve the efficiency and performance at EF2. Scores of project reviews in-house and by third parties attest to that. Also, whenever weaknesses were pointed out, Management took appropriate action. It should be recognized that an owner does not always control events and circumstances. Nor can he predict the outcome of his own actions or those of others. Often Edison, as owner of EF2, paid for events or misjudgements of others unrelated to EF2 occurring elsewhere. The TMI accident is a glaring example of this.

A second positive aspect of Edison Management is the humanitarian approach with which it dealt with complex human problems. Despite all its engineering and technical aspects, construction of a nuclear plant still involves complex human interactions. In the Staff's opinion, Edison took a fair minded and compassionate approach in resolving disputes, motivating craft and contractors. Perhaps in todays world of competition these are considered unnecessary impediments to efficiency and progress. The Staff believes that they are an essential ingredient of a successful project, particularly when public safety is involved.

On the important but delicate issue of safety, regulations and NRC compliance, Edison has walked a tightrope. All evidence indicates that Edison made safety of paramount concern and remained on guard to prevent a major quality control infraction. Whenever it came to the Management's attention, quality control and safety issues were faced squarely and courageously (terminating Parsons, taking over QA function from Daniel). On safety issues, Management did not compromise and often erred on the side of safety. Edison also showed good corporate responsibility on environmental concerns. Surely, in the Staff's judgement, they resulted in a somewhat more expensive plant. In the end, the Staff believes that Edison, and therefore its ratepayers, got a quality-built plant which will serve Michigan energy needs efficiently and reliably for years to come.