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STATEMENT OF BILLIE PIRNER GARDE

CITIZENS CLINIC FOR ACCOUNTABLE GOVERNMENT

ON THE

MIDLAND NUCLEAR POWER PLANT

LANSING, MICHIGAN

February 13, 1984

Government Accountability Project
1901 Que Street, Northwest
Washington, D.C. 20009
Telephone: 202/234-9382

FEB 16 1984

On behalf of the sixteen former workers and Midland residents whose affidavits Senator Johndahl has agreed to accept we thank him. Under the Michigan Whistleblowers Protection Act, Michigan Public Act 469, workers who wish to be protected under it must submit their information to a "public body." Unfortunately neither the Government Accountability Project (GAP), nor the Nuclear Regulatory Commission(NRC) qualify under the definition of "public body" according the Michigan Annotated Code. Mr. Johndahl's efforts have extended an extra measure of protection to those workers who have spoken out about the problems at the Midland Nuclear Power Plant.

Today the Government Accountability Project (GAP) also urges elected officials in the State of Michigan both the Governor and State Legislature to assume an additional oversight role. As summarized below we have found that the problems of the Midland Plant are being inadequately dealt with by the regulatory agencies empowered with protecting the citizens and ratepayers of this State. The efforts of a State Oversight Committee or Governor's Commission could provide answers to the problems of Midland which can no longer be avoided.

GAP is now entering the third year of our Midland investigation. In June '82 we had our first press conference in Lansing and announced turning over six worker affidavits to the NRC. We identified nine major areas of concern to GAP about the Midland Project. Some of these problems have gotten better, some have gotten immeasurably worse. Today we want to issue an update of our efforts, and to summarize the problems contained in the sixteen affidavits provided to date to the NRC.

MAJOR AREAS OF CONCERN THAT HAVE IMPROVED

(1) Nuclear Regulatory Commission Oversight. In June '82 the Midland Office of Special cases had just been announced. It has proven to be a trustworthy, dedicated team of inspectors who have proven they are willing to go out on the limb to insure that Midland in safe. Unfortunately the team is woefully understaffed for Midland's massive problems. That could be changed with letters from State officials to NRC Chairman N. Palladino or Regional Director Keppler.

(2) Recognition of a Quality Assurance Breakdown. Two years ago only the Intervenors and GAP recognized the seriousness of the QA breakdown at the Plant. Then, in fall 82, the OSC team did a surprise inspection which revealed all of the problems that workers had told us about, and more. In February 83 CPCo was fined $120,000.00 for a QA breakdown and agreed to a 100% reinspection of the plant. That reinspection, called the Construction Completion Program (CCP), is the most stringent in the nuclear industry today. The fatal flaw however, is that CPCo is still allowed to identify the problems. GAP has renewed its request to the NRC to remove CPCo from that critical role.

(3) The Catch - 22 Dow Contract. Two years ago we worried about the quality of construction as CPCo pushed workers to meet an impossible but critical deadline. In July 1983 Dow cancelled its order for steam. The pressure to complete the plant for Dow is now off, but unless CPCo can complete the plant and get it into the rate base the company will allegedly go broke.

MAJOR AREAS OF CONCERN THAT HAVE NOT CHANGED

(4) The location of the plant. The Midland nuclear plant is located within the city limits of a town of over 50,000. There are 2,000 industrial workers within two miles. An elementry school playground is back-to-back with the cooling pond. The location will never change, making the necessity for a safe plant even more critical than ever.

(5) The environmental impact The plant will emit extraordinary amounts of dense fog from the cooling pond in which routine and accidental radioactive releases will be entrapped. The issue of radioactive discharge into the already heavily polluted Tittabawassee river is currently in litigation.

MAJOR AREAS OF CONCERN THAT HAVE GOTTEN WORSE

(6) The Cost of Midland. In June 1982 the cost was projected at $3.39 billion, now the rate payers and investors wait with bated breath for the April cost and completion estimate. The cost, now at 4.43 billion, is expected to jump to over $5 billion. And none of these estimates include the cost of fixing the problems which will be identified in the CCP reinspection.

(7) The soils settlement issue. The cracked and sinking buildings at the plant, primarily the Diesel Generator Building (DGB) and the Auxiliary Building, have not responded to the "fix." New cracks have been identified in the Aux Building, and a recent study by the Brookhaven Laboratory concluded that the building cannot meet regulatory standards, the NRC thinks it will meet its "functional" requirements anyway. The Atomic Safety and Licensing Board (ASLB) will still have to approve the whole issue -- something not as predictable in the wake of the NRC denial of an operating license to Byron.

(8) Intimidation and reprisals against workers. Even CPCo's own witness testified in a December ASLB hearing that he was afraid of giving information to the NRC because of what happens to "whistleblowers." The information from the site continues to come in, workers are fired at the first sign of raising problems. Engineers and workers are moved from system to system so it is difficult to recognize serious flaws.

(9) Allegations from plant workers and engineers. Of the original affidavits from June 1982 almost every allegation has been substantiated. Concerns about drug abuse, poor welding, uncertified welding procedures, inadequate document control, major problems with the HVAC contractor, overloaded cable trays, failure to use Q-supports over Q-related systems, problems with the design of the control room, and on and on. The additional allegations are under investigation by the NRC, or have been "closed out," in recent inspection reports.

NEW AREAS OF CONCERN

(1) Economic Impact of the Plant. Electric rate increase predictions when the Midland plant goes "on-line" range from 35% to over 50%. Worries about rate schock are forcing municipalities and businesses to intervene in the rate case, or to develop separate sources of energy so they can unplug from CPCo before the rates increase.

(2) Inadequate Public Service Commission Staff Study on Waste/Mismanagement GAP recently announced a seperate investigation into the planned rate base inclusion study. That study predicts that only the soils problems will be recommended for exclusion because of mismanagement, instead of an adequate review of all of the reinspections and re-work resulting from mismanagement.

(3) CPCo's Mismanagement of Construction at Midland. Recent NRC investigations into violations of regulatory requirements concluded that the violations occurred with disregard for the law. The NRC has ordered a management audit of CPCo in an effort to getto the root of the problem.

SUMMARIES OF WORKER ALLEGATIONS

Outlined below is a list of over 65 allegations contained in the affidavits given to Senator Johndahl today. The NRC has received all of these affidavits, which include the first six submitted in 1982. Other whistleblowers have been directed to the NRC through GAP without preparing affidavits in a continuing effort to protect the sources of information.

Each affidavit represents one individuals' struggle with CPCo. None of the affiants still work at the plant, all of the engineers are working in other states now. To the extent that I can answer questions about the affidavits I will attempt to do so, however, that will be within the limits set by the workers themselves, the requests of the NRC so as to not comprimise on-going investigations, and GAP's own lawyers who are defending us from CPCo attorneys efforts to gain access to these affidavits.

These allegations come from engineers, quality control inspectors, welders, carpenters, document control clerks, pipefitters, security guards, and others.

--Improper welding procedures

--Inadequate inspection of Q-supports for Q-systems

--Improper use of Hilti-expansion bots as Q-supports

--Welding performed by unqualified welders

--Inadequate training by CPCo for QA/QC inspectors

--Falsification of engineering test data

--Massive field change notice and field change request backlog

--Uncertified/unqualified welders on HVAC equipment

--Inadequate installation of HVAC equipment

--Advance notice of NRC inspections

--The adequacy of the soils under the DGB pedestals

--Use of uncertified machinery in the soils testing program

--Improper backfill and cement in the backfill areas that required clean fill

--Pressure to speed construction

--Worker safety issues, including exposure to radiation from NDE equipment

--Substantial waste of tools, equipment, and materials

--Lack of vendor document control problems

--Unorganized, lost, destroyed or falsified controlled documents

--Lack of vendor QA for material traceability

--Harrassment and intimidation of workers

--Alteration or falsification of manufacterers specifications

--No formal training for document control clerk

--Poor morale among field workers and engineers

--Failure to notify the NRC about problems per 10 CFR 21

--Inadequate NRC inspections

(allegations, continued)

--Inadequate material control

--Inadequately controlled welding rods used

--slipshod security

--Installation of improperly inspected piping

--theft of tools on a regular basis

--wasted funds due to suspect installation blueprints

--Alcohol and drug abuse among work force

--Unsafe conduct of radiographs, endangering the workers

--Unqualified engineers performing field engineering

--massive mismanagement of the workforce

--Using welding standards below ASME/AWS welding codes

--Inadequate engagement of socket welds

--Approval of insuffucient fillet welds

--inadequate inspections of small bore piping

--Post-construction hanger design modifications

--Lack of properly torqued anchor bolts

--Lack of proper QC procedures for inspection of hangers and supports

--Institutionalized efforts to deceive QC inspectors

--Electrical cable sustitutions

--Overloaded cable tray

--honeycombed concrete

--Improper installation of type-30 conduit

--Material documentation problems

--Slow response to emergencies in the security force

--The "powerhouse shuffle," a way of looking busy but not working

--Poorly designed control room

(allegations, continued)

--A cost-plus contract which entitles Bechtel to a profit, plus expenses

--Pipe stress deficiencies

--Violation of NRC requirements for installation/training improvements

--Inadequate calculations used in piping system installation

--Installation of underpinning instrumentation cables without documented procedures

--Failure to correct identified QA/QC problems in a timely manner

--Gambling on site by Bechtel workers

--Inadequate anchor bolt embeds

--Unreported soil differential problems

--Instructions to workers to not report to NRC

--Company interference with union activities, including grievance procedures

--Changes to the required inspection criteria after NRC approval

--Failure to document all non-conforming items

--Systematic rotation of workers to prevent detailed understanding of a job

--Collusion between NRC officials and CPCo/Bechtel management

These allegations are currently under NRC investigation. Other allegations continue to service as GAP investigators run into former Midland employees at other nuclear plants across the nation. Each carries a Midland "horror" story, and another piece of the puzzle about the extent of the problems at the plant.

We are encouraged that the reinspection effort, the Construction Completion Program(CCP), is finally getting off the ground. Hopefully citizens and ratepayers, as well as CPCo stockholders will demand that they be allowed a voice in making the decision about whether or not the plant is worth compelting. That decision should be much easier to make at the completion of the current phase of the CCP which identifies the problems and outlines the repairs.

GOVERNMENT ACCOUNTABILITY PROJECT
Institute for Policy Studies
1901 Que Street, N.W., Washington, D.C. 20009 (202) 234-9382

February 13, 1984

HAND-DELIVERED

The Honorable James Blanchard
Governor of the State of Michigan
State Capitol
Lansing, Michigan

Re: Midland Nuclear Power Plant

Dear Governor Blanchard:

Over the past four months, representatives of the Lone Tree Council, a mid-Michigan environmental organization, have met with members of your staff. As you know, the Lone Tree Council has actively opposed the Midland Nuclear Power Plant under construction in Midland by Consumers Power Company. Its opposition is based on a combination of factors. As an environmental group, its foremost concerns have been about nuclear waste and environmental contamination and degradation; however, beginning in early 1982, Lone Tree Council members began receiving increasing reports from site employees of shoddy workmanship and conditions that could lead to serious safety problems. In March, 1982, the Government Accountability Project, a Washington-based public interest "whistleblowers protection" group began an independent investigation of the Midland Plant. That investigation will soon begin its third year.

The Midland Plant has been plagued from its onset with poor management, cost overruns, major construction defects, i.e., a sinking foundation and cracked building, and a recently disclosed quality assurance breakdown. Construction continues under the most stringent reviews and regulatory orders in the nuclear industry today. These requirements, however, fall short of being able to insure that if Midland is completed, it will be safe.

At other troubled nuclear projects across the country, i.e., Zimmer, Marble Hill, and Diablo Canyon, the State Governors took an active role in communicating concerns of safety and out-of-control projects to the Nuclear Regulatory Commission. Their efforts made a significant difference. We urge you to take similar action immediately.

Very truly yours,

Billie Pirner Garde

Billie Pirner Garde
Citizens Clinic Director

BPG:me

FOR IMMEDIATE RELEASE

Contact:
Tom Hearron
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(517) 790-4332

In 1982 the Lone Tree Council, in conjunction with the Government Accountability Project, released twenty-six allegations by current and former employees at the Midland Nuclear Plant, allegations of serious deficiencies in workmanship and quality assurance at what the Nuclear Regulatory Commission has called one of the most poorly constructed power plants in America.

Two years later, not all of the allegations have been investigated. Of those which have been properly investigated, not one has proved to be false.

At the insistence of Lone Tree Council, the Nuclear Regulatory Commission established for Midland the most stringent construction-review program in the history of the nuclear industry. And yet despite all the fanfare, despite Consumers Power's promises to mend its ways, it appears that it is "business as usual" at the Midland site. Workers continue to come to Lone Tree Council and to the Government Accountability Project. They come amazed, aghast, appalled at conditions and standards of construction at the plant.

We are here today to share with you our latest findings. Over one hundred allegations coming from sixteen workers are contained in affidavits which have already been turned over to the Nuclear Regulatory Commission. At other troubled nuclear plants such as Zimmer in Ohio and Marble Hill in Indiana, the governors of those states intervened to protect the physical and economic well being of their citizens. Thus, Lone Tree Council is in Lansing today to urge Governor Blanchard to review the unmitigated disaster that is Midland.

We are grateful to Senator Lynn Jondahl, who has accepted these affidavits under the provisions of the Michigan Whistleblowers Protection Act. We hope that more members of the State government will take an interest in the fiasco that is being built in the heart of Michigan. Unless our state officials heed the warnings of conscientious workers from the Midland site, this plant, a comedy of errors in building, will become a tragedy of errors in operation.

May 1, 1983

MEMORANDUM

TO: The Files
FROM: Mark Cohen and Tom Devine
RE: State authority to regulate nuclear power after Pacific Gas and Electric v. State Energy Resources Conservation and Development Commission

On April 20 the Supreme Court gave some teeth to state governments dissatisfied with the standards for federal approval of nuclear power plants. In the process, states gained the authority to largely compensate for lax safety oversight by the Nuclear Regulatory Commission (NRC). In Pacific Gas and Electric Company v. State Energy Resources Conservation and Development Commission, No. 81-1945 (April 20, 1983) ("Pacific Gas"), the Supreme Court unanimously held"that Congress has left sufficient authority in the states to allow the development of nuclear power to be slowed or even stopped for economic reasons." Id. at 30. Two members of the Court, Justice Blackmun joined by Justice Stevens, would have gone even farther. Justice Blackmun wrote that "a ban on the construction of nuclear power plants would be valid even it its authors were motivated by fear of a core meltdown or other nuclear catastrophe." Id., concurring opinion at 7.

This memorandum will briefly summarize the holding in Pacific Gas, as well as the options that states have to regulate nuclear power in the aftermath of the decision. The scope of the new legal limits necessarily was limited by the facts in dispute. The Court upheld the validity of Section 25524(b) of the California Public Resources Code, finding that state regulation of nuclear power for economic purposes is not preempted by the Atomic Energy Act of 1954. The specific issue in Pacific Gas concerned a moratorium on the construction of new nuclear plants until the State Energy Resources Conservation and Development Comission finds that the federal government has developed and approved a demonstrated technology or means for permanently disposing of high-level nuclear wastes. But the Court's rationale in upholding the moratorium could be extended to plants already under construction or on-line.

I. THE LAW IN THE AFTERMATH OF PACIFIC GAS.

The case came before the Court on a Writ of Certiorari filed by Pacific Gas & Electric Company and Southern California Edison Company. The petitioners contended -- (1) the California statute, because it regulates nuclear plants and is allegedly founded on safety concerns, falls within the field of exclusive federal control carved out by the Atomic Energy Act of 1954 and subsequent amendments; (2) the statute conflicts with Congressional and NRC decisions concerning nuclear waste disposal; and (3) the California statute frustrates the federal goal of developing nuclear technology as an energy source.[1]

The Supreme Court rejected all three challenges to the law. First, the Court held that the legislative history of the Atomic Energy Act indicates that Congress intended to place regulation of radiological safety aspects involved in the construction and operation of nuclear plants in federal hands, "but that the States retain their traditional responsibility in the field of regulating electrical utilities for determining questions of need, reliability, cost and other related state concerns." Id. at 12.

The Court explained that the NRC does not purport to exercise its authority based upon economic considerations. Recently, the NRC even repealed its own regulations concerning a utility's financial qualifications to construct and operate a nuclear plant. The Court reasoned that "[i]t is almost inconceivable that Congress would have left a regulatory vacuum; the only reasonable inference is that Congress intended the states to continue to make these judgments [regarding economic considerations]." Id. at 19.

While the Court held that the federal government has occupied the field concerning safety regulation, it agreed with California that the State statute aims at regulating economic, not safety problems. The State had argued that the absence of a federally approved method of waste disposal created a "clog" in the nuclear cycle which could result in economic consequences from plant shutdowns.

The Court concluded that states have the authority "to halt the construction of new nuclear plants by refusing on economic grounds to issue certificates of public convenience in individual proceeding Id. at 23.

Second, the Court found that the statute does not conflict with federal regulation of nuclear waste disposal. The fact that the NRC has concluded that it could continue to license new reactors given progress toward the development of disposal facilities and interim storage sites is not dispositive. Writing for the Court, Justice White stated that NRC licensing "indicates only that it

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1/ The Court held that another provision of the statute, requiring that the State Commission determine on a case-by-case basis that there will be "adequate capacity" for interim storage of the plant' spent fuel at the time the plant requires such storage, is not "rip for adjudication until the state commission actually has to make a decision. (Id., at 10.)

is safe to proceed with such plants, not that it is economically wise to do so." Id. at 25.

The Court also ruled out passage of the Nuclear Waste Policy Act of 1982, Pub.L. 97-425, ___Stat.____(1982) which authorizes repositories for disposal of high-level radioactive waste and spent nuclear fuel, as an answer itself to California's challenge. The Court explained that while the new law "may convince state authorities that there is now a sufficient federal commitment to fuel storage and waste disposal...it does not appear that Congress intended to make that decision for the states through this legislation." Id. at 27.

Finally, the Court held that the California statute does not frustrate the Atomic Energy Act's purpose of developing the commercial use of nuclear power. While "a primiary purpose of the Atomic Energy Act was, and continues to be, the promotion of nuclear power," id. at 28, the Court upheld the Ninth Circuit's caveat, stating "that the promotion of nuclear power is not to be accomplished 'at all costs.'" States, the Court concluded, may choose alternative energy sources to nuclear power based on economic grounds.

II. STATE OPTIONS TO REGULATE NUCLEAR POWER IN THE AFTERMATH OF PACIFIC GAS

The Supreme Court cannot establish legal rules that reach beyond the facts of the case; any other conclusion would be nonbinding dictum. As a result, the new decision only approves economically-motivated moratoriums on construction of new nuclear plants. A close reading of the Court's analysis suggests that it also applies to nuclear plants already on-line or under construction, however. Seven of nine justices took the initiative to emphasize in dicta that new state authority does not extend to safety issues. But there is no hint that states only have the power to regulate the economic effects of nuclear plants in the planning stage. The same economic rationale for Pacific Gas applies even more strongly to the side-effects of inefficient or dangerous nuclear "lemons."

The new options for states in light of Pacific Gas are summarized below, along with the state authority that already exists.

A. New Options Resulting From Pacific Gas

Since there are economic consequences from any significant activity states which creatively apply Pacific Gas can require complete accountability from the nuclear industry. Many opportunities parallel current state authority to regulate the costs of electricity.

In general, the distinction is that now states can use these approaches to impose a statutory ban on construction, and probably on operation, through legislation or citizen referenda. Formerly, states could enforce economic principles merely through rate-making regulation by public utilities commissions whose commitments were questionable, or through imposition of liability after-the-fact for the consequences of an accident. By that point, the damage is done and there are reasonable arguments to protect the utility's investment, even if the initial decision was unwise. After Pacific Gas, states can prevent nuclear faits accompli from occurring.

The examples of state opportunities after Pacific Gas listed below are by no means comprehensive; they are offered to illustrate the range of new options.

1. Economic Impact Studies -- States could impose a moratorium on new construction until the utility obtains state approval of an economic impact study demonstrating that construction of a new nuclear power plant offers a net cost-benefit advantage to its citizens. Required topics for the study could include the need for additional electric generating capacity, as well as an economic analysis comparong a new nuclear facility to all other energy sources.

This same rationale could be extended to plants under construction or on-line. States would merely establish a trigger mechanism that required updating the economic analysis in light of significant developments during construction and operation. If work at a nuclear "lemon" is halted late in construction to undertake massive repairs, direct costs could escalate by hundreds of millions of dollars. Delays would further exacerbate cost increases due to interest on loans. The state could prevent the utility from beginning the repairs until a revised economic impact study was completed. At that point, it may be cheaper on-balance to convert the facility or scrap it altogether.

Similarly, the requirement could be imposed for plants on-line that are closed down due to an accident, or to conduct major unanticipated repairs. For example, at Three Mile Island the Supreme Court has ruled that psychological trauma is not a relevant environmental consideration under the National Environmental Policy Act. But the economic consequences of psychological trauma could be devastating if a significant percentage of the population tried to leave due to fear that the facility will reopen. Real estate values could fall, the tax base could be depleted, and business investment in the area might be threatened.

2. Financial Qualification -- States can now impose a moratorium on construction of new plants until the owners demonstrate their financial ability to compensate for the effects of an accident At TMI, the utility's survival has been threatened by the economic

consequences of the accident. In some states, utilities might also have to pay massive damages from tort suits brought by a multitude of citizens suing under strict liability after an accident. A community's economic base could be badly damaged either if the utility went bankrupt or was unable to pay local citizens for damages incurred on a mass level.

3. Reasonable Assurance of Stable Federal Safety Regulation -- Through this approach, states could require federal reassurance that the safety implications of nuclear technology have been sufficiently mastered to permit reliable economic planning. Utilities have long complained that the Nuclear Regulatory Commission is responsible for construction delays due to changing the technological rules in the middle of the game. The NRC has responded that it has little choice, since it has a duty to act on previously unknown safety implications of a developing technology. Regardless of fault, the financial consequences of these delays can be significant.

States now can impose a moratorium on new construction until the government issues a certificate of "reasonable assurance" that the state-of-the-art technology at the beginning of construction is sufficient to complete construction under the Atomic Energy Act. Presumably, the NRC would issue such a certificate for each plant, since all designs are unique to some extent for each facility.

4. Financial Impact of Safety Risks Accepted by the NRC --

Citizen intervenors have long complained that the legal process to license nuclear plants is fundamentally deficient. They criticize decisions that accept certain safety risks, or that classify the safety challenges as "generic" to the industry and therefore not relevant for an individual licensing proceeding. Unfortunately, often the plants begin operating before the NRC has addressed the nuclear industry's generic defect. States now can partially fill this loophole by requiring approval of an economic analysis demonstrating that the potential consequences from the risk accepted by the NRC, or from the generic flaw, are acceptable in light of the costs of delaying the plant to make the repairs sought by intervenors.

B. Existing State Authority.

Even before Pacific Gas, the steady trend has been for an increased state role in the nuclear regulatory scheme. The Supreme Court referred with approval to examples of the trend. The options for state initiatives before Pacific Gas are summarized below

1. Pollution Control Laws -- Both the Clean Air Act Amendment of 1977 and the Water Pollution Prevention and Control Act provide for an active state role in protecting the environment.

The Water Pollution Prevention and Control Act provides that "[i]t is the policy of the Congre-s to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution [to land and water resources 33 U.S.C. § 1252(b)(1976).

Even more specific are the Clean Air Act Amendments of 1977, which give the states authority to regulate radioactive air emissions from nuclear plants, 42 U.S.C. §7422 (Supp. III 1977), and allow the states to set emission standards more stringent than those imposed by the NRC. 42 U.S.C. §7416; H.R. Conf. Rep. No. 95-564, 55th Cong., 1st Sess. 143, reprinted in [1977] U.S. Code Cong. & Ad. News 1502, 1523-24. In effect, the Clean Air Act Amendments legislatively overruled earlier judicial prohibitions of authority to regulate radioactive waste emissions. See, e.g., Northern States Power Co. v. Minnesota, 447 F.2d 1143 (8th Cir. 1971), aff'd, 405 U.S. 1035 (1972); City of Cleveland v. Public Utilities Commission, 64 Ohio St. 2d 209, 414 N.E.2d 718 (1980).

2. Traditional Utility Regulations -- (a) State authority over utility rates offers a second opening to regulate nuclear plants. As TMI already had revealed, economics and safety are not entirely separable. A nuclear facility which is unsafe is also unreliable. This could result in enormous charges for the purchase of replacement power which the utility will seek to pass along to ratepayers. States can prohibit any automatic pass through of these increased costs to consumers.

(b) A bill introduced last year in the New Jersey legislature would require that whenever a utility seeks to recover costs of more than ten million dollars for a nuclear accident by imposing a rate increase, the utilities board must conduct hearings on the accident in order to make a finding of fault. Utilities would be denied recovery from its ratepayers for any "fault-related" repair. Additionally, the utility would be liable for a variety of penalties including a reduction in its permissible rate of return on equity for a designated period of time.

(c) A state can apply the "used and useful" standard to seek exclusion of units from the rate base which have poor operating records and/or are in need of expensive reworking. This approach allows construction to continue, but without a subsidy from the ratepayers.

(d) States can levy assessments against utilities to generate funds for both the costs of decommissioning and long-term waste storage and disposal. This fund could be used to provide energy conservation loans at negligible interest rates to low-income citizens.

3. Emergency Evacuation Plans -- Under the Atomic Energy Act, the state "police power" already is used to directly regulate emergency preparedness plans of the utility and/or to support the exercise by local governments of their "police power" to regulate evacuation plans.

There is considerable evidence, based upon the experience at Three Mile Island and studies conducted at other nuclear facilities, that existing emergency preparedness is woefully lacking. Far greater numbers of people evacuated at TMI than were ordered to do so by Governor Thornburg. This mass evacuation sorely taxed the available emergency preparedness resources. There is also compelling evidence that when confronted with the TMI alert a significant portion of the emergency preparedness personnel went home to protect their families rather than to assist in the evacuation, which further exacerbated the inadequate emergency resources. States can insist through the exercise of "police powers" that an adequate emergency plan be in place, perhaps ratified in a referendum by people in communities surrounding the nuclear plant. This would be particularly appropriate in light of the NRC Atomic Safety and Licensing Board's June 1982 rejection of an operating license at Zimmer, due to inadequate evacuation plans.

4. Enact or Extend Tort Laws -- (a) The Tenth Circuit in Silkwood v. Kerr-McGee Corp., 667 F.2d 908, 921 (10th Cir. 1981), held that Oklahoma's imposition of tort liability in a situation where a quantity of plutonium had escaped the plant site and caused damage did not significantly interfere with the federal regulation of the Kerr-McGee facility. The state imposed a strict liability standard, consistent with accepted legal authority. "Some activities such as the use of atomic energy, necessarily and inevitable involve major risks of harm to others, no matter how or where they are carried on." Restatement (Second) of Torts §520, comment (g)(1977).

(b) The court in Marshall v. Consumers Power Co., 65 Mich App. 237, 237 N.W.2d 266 (1976), held that state courts were not prevented under the preemption doctrine from considering complaints concerning nonradiological hazards from a nuclear plant based upon a nuisance theory. Since a construction license granted by the AEC is merely a permit and not a federal order to build, that court held that Michigan could stop a power company from operating until it meets reasonable standards or abates a nuisance, unless that would make construction of the plant impossible.

5. Gubernatorial Agreements -- Under §274(b) of the Atomic Energy Act, a Governor may reach an agreement with the NRC under which the state would take over health and safety regulation of most nuclear materials. 42 U.S.C. §2021(b)(1970). The state program must be compatible with NRC objectives. As an example, New York City, through a gubernatorial agreement, gained the acquiescence of the Department of Transportation in a health code ban on nuclear shipments through the city. New York Times, (Apr. 5, 1978) at A27, col. 5.

6. Vermont Approach -- Vermont has used its "general authority" as part of a "carrot and stick" approach toward the nuclear industry. To gain the State's approval of a bond issue, the Yankee Nuclear Power Company "voluntarily" agreed to submit to regulation by the Vermont Public Service, Water Resources, and Health Boards and waived the defense of federal preemption. No law prohibits a nuclear company from exceeding federal standards on its own initiative, so waiver of the preemption doctrine is permissible..

7. Education -- A state can undertake to inform and prepare citizens living in the vicinity around a nuclear plant of hazards they face and precautions they might take. Tennessee, for example, dispenses potassium iodine to residents living with a ten-mile radius of a TVA nuclear facility. Residents are cautioned to swallow capsules in the event of a nuclear "incident," not as a radiation remedy but as a tracer substance to measure radiation exposure.

III. CONCLUSION

The implications of Pacific Gas must be confirmed through additi cases that apply the Court's reasoning. The significance of the decision is clear, however: states no longer can pass the buck to federal government for the consequences of ill-conceived or poorly constructed nuclear power plants. Pacific Gas removed any remainin doubts. If anything, states now have more authority than the NRC to regulate nuclear power plants.

LONE TREE COUNCIL

P. O. Box 421
Essexville, Michigan 48732

February 13, 1984

The Honorable James Blanchard
Governor of the State of Michigan
State Capitol
Lansing, Michigan

Re: The Midland Nuclear Power Plant

Dear Governor Blanchard:

Over the past several months members of the Lone Tree Council, a mid-Michigan enviromental organization, have met with members of your staff. As you know we are concerned with the financial, economic, and environmental problems associated with the Midland Nuclear Power Plant. For the past six years we have opposed the plant's completion as unneccesary and unsafe. In the past two years we have worked actively towards requiring that an independent audit be conducted of the entire plant. That audit began last week as the Construction Completion Plan (CCP) began the first phase of the Quality Verification Program (QVP). At the completion of the QVP (a dynamic reinspection program of 100% of accessible hardware at the site) there will be a perfect opportunity to re-evaluate the future of the Midland plant.

We are submitting to your staff a proposal for an INDEPENDENT COMMISSION TO STUDY THE PROBLEMS PRESENTED BY THE MIDLAND PLANT. Attached to that proposal is an eight-page legal analysis of the role that state's can play in regulating and controlling nuclear power plants in the light of recent U.S. Supreme Court decisions, particularly Pacific Gas and Electric v. State Energy Resources Conservation and Development Commission.

We look forward to your response in the near future.

Sincerely,

Tom Hearron

Tom Hearron
Chairperson

*ORGANIZATIONS LISTED FOR IDENTIFICATION PURPOSES ONLY

AN INDEPENDENT COMMISSION TO STUDY THE PROBLEMS PRESENTED BY THE MIDLAND PLANT

PROPOSAL

Submitted by:

The Lone Tree Council
Michigan

PROPOSAL

FOR THE GOVERNOR AND AIDES

An independent commission to study the problems presented by the Midland Nuclear Power Plant, currently under construction in Midland, Michigan by Consumers Power Company (CPCo).

RATIONALE:

1. Midland is recognized as one of the most troubled plants in the nation by the Nuclear Regulatory Commission (NRC).

2. It's owner, CPCo, is now the second-worst rated utility investment on Wall Street..

3. The rate increase for the Midland plant will be between 35 -60% for ratepayers of CPCo, if the plant goes on line.

4. The devastation of CPCo if the plant does not go on line will be a major problem for the state government, which will be faced with either an energy reorganization crisis, or a bail out for CPCo.

5. The citizens of Michigan will be forced to increase taxes to either pay the electric bills of those citizens on fixed incomes who cannot afford the higher rates, or to bail out CPCo. if the plants closure forces them into reorganization.

WHY AN INDEPENDENT COMMISSION?

1. The Public Service Commission(PSC) has forfeited the opportunity to take control of the Midland project.

2. The PSC staff has lost the credibility needed to perform an unbias and independent assessment of problems and options.

3. The Nuclear Regulatory Commission does not assess costs or needs.

4. The Attorney General's limited resources are being spent on fighting the inclusion of the plant in the rate base.

WHAT PURPOSE WILL THE COMMISSION SERVE?

1. To seek solutions to the impending problems.

2. To recommend to the parties and to the citizens and rate-payers a range of options.

3. To be prepared for dealing with whichever reality comes to pass.

COMMISSION DETAILS

I. Members and Staff

A. A panel of experts in the following fields should be selected by the Governor:

1. Financial Analyst
2. Energy Analyst
3. Consumer Advocate
4. Business Representative
5. Union Representative
6. Small business representative
7. Community/City representatives
8. Representative for those on fixed-incomes

B. A staff should be hired, with positions coming (on loan) from each effected agency. The Staff for the Commission should work directly under the newly appointed position of Director of the Energy Administration Agency.

II. Activities of Commission

A. Through a series of hearings, solicitations of papers, or other means the Commission should:

1. Identify the problems for the State of Michigan and its taxpayers the result from the Midland plant completion or cancellation.

2. Ascertain the actions planned by the Company for either reality, and the extent to which it is capable and/ willing to assume the burden of social responsibility

3. Employ consultants with expertise in modelling the realities as presented by the Company, and measuring impacts of rates or lost investments on identified groups of customers.

4. Seek solutions from experts in alternative energy sources.

5. Determine a baseline cost over which the plant becomes a negative factor.

6. Make recommendations to the Company, the Public Service Commission, and the public.

III. Legal Authority

Attached is a legal memorandum detailing state suthority to involve itself with the construction of nuclear power plants.

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

FEB 1 6 1984

PRINCIPAL STAFF			
RA		DPRP	
D/RA		DE	
A/RA		DRMSP	
PC		DPMA	
PAO		SCS	
SGA		ML	
		File	

Docket Nos: 50-329 OM, OL
and 50-330 OM, OL

MEMORANDUM FOR: R. L. Spessard, Director
Division of Engineering
Region III

FROM: D. G. Eisenhut, Director
Division of Licensing

SUBJECT: REVIEW OF STRUCTURAL DESIGN ADEQUACY OF THE MIDLAND HVAC SYSTEMS

REFERENCES:

a. "Summary of October 4-7, 1983 Audit and Meeting on the Midland Heating, Ventilation and Air Conditioning Systems", Memorandum by D. Hood dated February 14 , 1984.

b. "Summary of October 27, 1983 Meeting on Midland Heating, Ventilation and Air Conditioning Systems", Memorandum by D. Hood dated February 14 , 1984

Your memorandum of August 4, 1983 requested NRR technical support in order that the combination of our respective efforts and those of Franklin Institute will address the adequacy of the safety-related HVAC systems as they are constructed and allegations of former Zack employees. To this end, NRR and Region III conducted a design audit on October 4 - 7, 1983 which is summarized by Reference a. A follow-up audit (Reference b) was also conducted on October 27, 1983.

The technical evaluations by NRR resulting from this effort are presented in Enclosures 1, 2 and 3. Enclosure 1 addresses the structural design adequacy of the Midland HVAC systems and is based upon the evaluation by Mr. D. Terao of our Mechanical Engineering Branch. In support of Enclosure 1, Enclosure 2 updates the staff's review of relevant functional aspects of the HVAC design as reported in the Midland SER in May 1982. Enclosure 2 is based upon the evaluation by Mr. W. LeFave of our Auxiliary Systems Branch. Enclosure 3 addresses results of the review of the Midland HVAC materials specification and materials records, and comments on the results of materials testing by Franklin Institute. Enclosure 3 is based upon the evaluation of Mr. C. D. Sellers of our Materials Engineering Branch.

Should you require our further assistance in this matter, please do not hesitate to contact us.

Darrell Eisenhut, Director
Division of Licensing

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FEB 21 1984

Enclosures:
As stated

ENCLOSURE 1

EVALUATION OF STRUCTURAL DESIGN ADEQUACY
OF MIDLAND HVAC SYSTEMS

I. Applicable Codes and Standards for HVAC Ductwork and Support

Presently, there are no national codes or standards which provide specific requirements for the overall design, fabrication, and installation of HVAC systems in nuclear facilities. The only national standard which addresses the design and construction of duct systems in a limited manner is ANSI-N509, "Nuclear Power Plant Air Cleaning Units and Components." ANSI-N510 covers the functional system testing aspects. The ANSI-N509 standard does not require specific material documentation.

Typically, the HVAC systems of nuclear facilities have been designed according to the guidelines shown in Sheet Metal and Air Conditioning Contractors National Association (SMACNA) publications, "Low Velocity Duct Construction Standards," which is applicable to duct pressures up to 2 inches water gauge and, "High Velocity Duct Construction Standards," which is applicable to duct pressure up to 10 inches water gauge. These design standards are based on performance only and are not based on the stress and deflection considerations associated with seismic Category I structures.

The American Iron and Steel Institute (AISI) code was adopted by the applicant for the Midland facility to govern the design of seismic Category I ductwork because of its applicability to thin gauge sheet metal.

The American Institute of Steel Construction (AISC) Code, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," was used for the design of the HVAC ductwork supports.

The supports and ductwork were welded in accordance with the American Welding Society (AWS) Structural Welding Code (AWS D1.1), Specification for Welding Sheet Steel in Structures (AWS D1.3), and Specification for Welding of Sheet Metal (AWS D9.1).

II. Documentation

Because there are no national codes nor standards which specify the documentation required, the documentation requirements become the responsibility of the Utility (or its architect-engineer) to define.

For Midland Plant Units 1 & 2, the architect-engineer, Bechtel Power Corporation provided a technical specification for HVAC Work (Spec. No. 7220-M-151A[1]) which specifies the documentation requirements. The technical specification requires that a certificate of conformance is necessary for all requirements of the technical specification. A certificate of conformance is a written statement signed by a qualified party certifying that the items or services comply with the technical specification requirements.

A material certificate of compliance is required by the technical specification to be provided for subcontractor-supplied (Zack) construction materials including dampers, diffusers, grilles, registers, air flow measuring units, ductwork, hangers, supports, and miscellaneous materials specifically identified by the technical specification. A material certificate of compliance is a written statement signed by a qualified party certifying that the materials are in accordance with a particular material specification.

When required by the referenced codes or material specifications, the material certificate of compliance is required to be accompanied by a certified material test report (CMTR). When the requirements of the technical specification are more stringent than the referenced code or material specification, the material certificate of compliance is required to be accompanied by a CMTR which demonstrates compliance with the more stringent criterion. For example, ASTM specification A526 does not require a mechanical strength test for the sheet steel and, thus, no minimum yield strength is specified. However, the technical specification [1]M-151A requires a minimum yield strength of 30 ksi for A526 and A527 sheet steel. The CMTR includes all chemical, physical, mechanical, and electrical property test data required by the material specification, applicable codes, and procurement documents. The CMTR includes a statement of conformance that the material meets the technical specification requirements.

III. Materials

The technical specification (M-151) for HVAC ductwork specifies the materials for the HVAC ducting, stiffeners, fasteners, and supports. For the typical duct details, the materials used are standard commercial grade materials. The sheet steel is typically galvanized carbon sheet steel conforming to ASTM A526-71 or ASTM A-527 with a coating designation G-90 and a minimum yield strength of 30 ksi. Carbon steel sheet includes ASTM A366-72 (minimum yield strength of 30 ksi) and ASTM A607-75, Grade 50. An austenitic stainless steel sheet or plate (Type 304-2B, ASTM A240-75A) with a minimum yield strength of 30 ksi is also specified.

For support steel, the technical specification requires that carbon steel structural shapes, bar sizes, and plate conform to ASTM A36-75, ASTM A572-77A, (Grade 50), and ASTM A284 (Grade A) with minimum yield strength of 36 ksi. Structural tubing conforms to ASTM A500-77 (Grade B) and angles 2½ inches by 2½ inches by ¼ inch and smaller conform to ASTM A575 (Grade 1020) with a minimum yield strength of 36 ksi.

Ca bon steel fasteners (including Huck bolts and sheet metal screws) conform to ASTM A325 galvanized and ASTM A307-74 galvanized. The only acceptable substitute permitted by the Midland technical specification for ASTM A325 is ASTM A490-76a. Acceptable substitutes for ASTM A307 are ASTM A193-76, ASTM A354-766, ASTM A449-76c, ASTM A490-76a, ANSI B18.2.1-65 with CMTR, or ASTM A325.

IV. Structural Design Margins

In order to determine the structural adequacy of the HVAC system (supports, stiffeners, and ducting), it is necessary to ask ourselves the following question, "Is the structural design of the HVAC system adequate if the materials used are questionable?" It logically follows that if the design margin to failure is large and if the range or possible variation in material properties in question (e.g., mechanical strength) is small, then we can reasonably conclude that the design is adequate. The adequacy or design margin can be expressed in the form:

$$\text{design margin} = \frac{\text{allowable stress}}{\text{calculated stress}}$$

For the components to be acceptable the design margin must be greater than 1.0. The larger the value, the more design margin is available. If the design margin is less than 1.0, then the question arises, "Will the component fail?" In order to answer the question, it is necessary to define what is meant by "failure". It is also important to understand what the basis is for the allowable stress.

In the following sections, we will be comparing the potential reduction in material strength due to substitute materials with the typical design margin for the various structural components in the HVAC system. The structural components that will be covered include the following:

A. Structural Steel Supports and Welds
B. Ductwork and Stiffeners
C. Ducting Companion Flange Bolts
D. Concrete Expansion Anchor Bolts

A. Structural Steel Supports and Welds

For the Midland HVAC supports, the design specification[1] requires the use of carbon steel structural shapes, bar sizes, and plate to conform to ASTM A-36, A-572 Grade 50, and A-284 Grade A, structural tubing to conform to A-500 Grade B, and angles to conform to A575 Grade M-1020. The material minimum yield strengths and minimum tensile strengths of the HVAC support steel are provided in Table 1.

The structural steel used for the Midland HVAC support member is designed in accordance with the AISC, "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings."

The applicant specified in its design guide[2] the allowable stresses for the structural steel and tube sections as follows:

Allowable stress in accident conditions:
bending and torsion = 0.9 Fy
shear = 0.5 Fy

where Fy is the material yield strength.

In the calculations reviewed by the staff, it was found that the material yield strength used for the support steel was assumed to be 36 ksi. It was noted by the staff that the applicant prudently used a 36 ksi yield strength for a structural tube steel (A500) which actually had a minimum yield strength of 46 ksi. Typically, the applicant used 36 ksi yield strength for all structural steel in the support calculations. It should be noted that because the tube steel is welded in construction, the use of 36 ksi is prudent since its higher tensile strength resulting from coldwork will be annealled out in welding.

For the A284 Grade A plate material, the minimum yield strength is only 25 ksi. Although, the staff did not review specific calculations for the A284 material, it was concluded by the staff that the design margin for plates is large, thus, if the applicant had used 36 ksi instead of 25 ksi for the plate material, it is unlikely that the actual stresses would be near yield. The design margin to the allowable stress in accident conditions for a plate was found to be 7.7. The design margin to failure is greater than 10.0.

For A575 (M1020) material used as angles in the Midland HVAC supports, the ASTM specification does not require mechanical tensile tests. However, the Midland technical specification[1] does require a minimum yield stress of 36 ksi for A575 material. Because several grades of A575 are available with lesser carbon content (and thus lesser strength) than Grade M1020, the strength properties of the lesser grades needed to be determined to evaluate whether the design adequacy could have been compromised. The staff obtained typical test results from Northwestern Steel and Wire Company for various grades of A575 material. The values are shown in Table 2. Thus, it appears that the lowest grade (M1008) of A575 material could exhibit strength properties approximately 10% less than that required by the design specification.

The typical design margins for HVAC supports are provided in Table 3 of this report. As can be seen, the support steel (wide flanges, angles, plates, and tube steel) exhibit substantial design margin to the allowable stress at accident conditions.

It should be noted that the staff found other conservatisms in the HVAC support design. One conservatism is the damping values specified for the seismic building response spectra used in the HVAC support analyses. The supports (welded structures) are designed using a damping value of 2% for both OBE and SSE loads. Regulatory Guide 1.61 allows for welded steel structures 2% for OBE and 4% for SSE. The ratio of the maximum peak acceleration for the SSE at 2% to the maximum peak acceleration for the SSE at 4% is approximately 1.4. Thus, at the maximum peak acceleration, the use of the 2% damping results in an additional design margin of approximately 1.4 for welded steel structures.

It should be noted that the HVAC duct is more rigid than the HVAC supports because of the conservative 8-ft span criterion. Typically, the HVAC duct fundamental beam bending frequency between support spans of 8 ft is approximately 150 hertz (with the lowest frequency approximately 55 hertz) whereas the fundamental frequency of HVAC supports are typically less than 33 hertz.

The welds for HVAC supports are governed by AWS D1.1-72. Weld tensile strength is assumed to be 60 ksi for E60 electrode. For a 3/16" fillet weld the allowable weld strength is :

= (effective area of weld)($.3\sigma_u$)

where σ_u = ultimate weld tensile strength

= (3/16 cos 45°)(0.3)(60,000)

= 2386 lbs/inch

For accident conditions, a 50% increase in the design allowable is used resulting in an allowable strength of 1.5 x 2386 = 3579 lbs/inch. The design margin to ultimate breaking strength is, 48,060/27,000*= 1.78 at the accident condition allowable weld strength.

As shown in Table 3, the design margin to the allowable weld strength at accident condition varies from 1.3 to 33.3 and is in addition to the 1.78 margin described above. Thus, the staff concludes that welds have a substantial design margin to failure.

B. HVAC Ductwork and Stiffeners

For HVAC ductwork, the staff found that typically A526 or A527 sheet steel is used. However, the design specification[1] also stipulates the use of carbon steel sheet material A366 and A607 Grade 50 and austenitic stainless steel sheet (or plate) Type 304-2B, ASTM A240. The material minimum yield strengths and minimum tensile strengths of the HVAC ductwork are shown in Table 4.

In order to understand the design margins in the HVAC ductwork, it is important to clarify the analytical and testing methods used by the applicant in qualifying the ductwork.

The applicant does not follow the design guidelines of the SMACNA standards but rather uses the generic design guidelines as depicted in their HVAC drawings C-842 through C-849. The staff has compared the differences between the SMACNA standard and the Midland HVAC drawings and has found that the Midland sheet metal thicknesses and stiffener sizes tend to be larger than those specified by SMACNA for the corresponding duct sizes and is, thus, conservative. The SMACNA stiffener spacing tends to be closer than the spacing used at Midland. However, because the stiffener is primarily used to prevent buckling of the sheet metal, the additional thickness of the sheet metal compensates for the increased stiffener spacing.

In 1977, the architect-engineer for the Midland facility (Bechtel Power Corporation) sponsored testing of the HVAC duct specimens for the Limerick plant.

The test results were used to develop a Bechtel generic HVAC duct design guide[3] which was used for the Midland plant. The main goals of the Duct Test Program[4] were:

a) To substantiate the use of width to thickness (w/t) and height to thickness (h/t) ratios of up to 1500 while maintaining the AISI specification as the basis for design.

b) To justify stiffener design.

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* The AWS D1.1 allowable weld stress is 18,000 psi and the corresponding weld stress for the accident condition is 1.5 x 18,000 or 27,000 psi. AWS D1.1 also states that the ultimate breaking strength of fillet welds and partial joint penetration groove welds shall be computed at 2.67 times the basic allowable stress for 60 ksi tensile strength . Accordingly, 2.67 x 18,000 = 48,060 psi.

c) To obtain a rational design method for the structural design of HVAC ducts by correlation between theoretical prediction and experimental results.

d) To assure that the duct details and materials used would not cause any fabrication problems when full scale production began.

The testing was performed by Hales Testing Laboratories of Oakland, California. The testing was based on A526 and A527 ductwork material with a minimum yield strength of 36 ksi. The significant conclusions of the testing included the following results.

- Failure modes of the ducts were not catastrophic and there was a great reserve strength after failure.

- Pressure loading was the most important loading. Live load and seismic loads were less important.

- Effect of seismic loads can be simulated by pressure loads.

- The primary failure modes of rectangular ducts were by corner crippling of sheet and by stiffener buckling.

- Live load stresses in the sheet and stiffeners were low.

The Bechtel generic HVAC duct design guide was used to qualify the ductwork spans in the Midland plant. The calculations assumed a minimum yield strength of the duct material to be 30 ksi. Thus, the ductwork materials specified in the design specification all meet or exceed the 30 ksi value. It should be noted that the ASTM Specification for A526 and A527 material does not require mechanical tensile strength tests. The Midland design specification[1] does require that the sheet metal (where there are no ASTM tensile test requirements) be purchased with a minimum of 30 ksi yield stress. The staff reviewed several purchase orders and confirmed that for the A526 and A527 material, the yield strength and ultimate tensile strengths were specified by the supplementary test requirements. All purchase orders reviewed showed that the yield strengths for safety-related duct material were greater than 30 ksi. With regard to material substitution, the staff has found that drawing quality sheet steel can have a yield stress as low as 25 ksi. However, the staff concluded that approximately 20% decrease in yield stress (25 ksi vs. 30 ksi) is not a significant concern because of the adequate design margins in the HVAC ductwork. The HVAC ductwork design margins are shown in Table 5 of this report.

C. <u>HVAC Ductwork Companion Flange Bolts</u>

The standard bolts used in the HVAC ductwork companion flanges are 3/8 inch diameter and made of A307 low carbon steel. The generic design detail is shown on Midland Dwg No. C-844 (Q) and specifies a 6-inch maximum spacing between the bolts in the companion angle flange connections. The calculation[5] of the 3/8-inch bolt loads was performed for the worst case loadings and included many conservatisms. The calculation was based on A307 bolt material with an allowable design stress of 20 ksi (per AISC Manual of Steel Construction). A307 bolts (Grades A and B) are required by the ASTM specification to have a minimum tensile strength of 60 ksi. The allowable tension was calculated as follows:

Allowable tension load = (20 ksi)(0.078 in^2)(1.5)
(accident condition) = 2340 lbs.

The ASTM (A307) tensile strength requirement for 3/8 inch diameter bolts is 4650 lbs. Thus, there is a design margin of 2 to failure at the allowable tension load at accident conditions. The staff found that assuming one bolt is effective in each corner of the flange, the bolt has adequate strength to accommodate the applicable loads and load combinations. The staff found the bolt calculation to be based on conservative assumptions and the results show an adequate design margin. It should be noted that prying action (steel-to-steel) was considered in the calculation per AISC (8th Edition). A summary of the bolt design margin from the calculated load to the allowable bolt load at accident condition (2340 lbs) for several duct sizes are shown in Table6 .

D. Concrete Expansion Anchor Bolts

The HVAC ductwork supports are generally anchored to reinforced concrete foundations with expansion anchor bolts. The drilled-in concrete expansion anchor bolts are supplied by Hilti Fastening System for all sizes except for 7/8 inch nominal diameter bolts. The 7/8 inch bolts are supplied by Phillips Drill Company. The material properties are shown in Table 7.

In reviewing the design margins in Table 3 of this report, it can be seen that the anchor bolt tends to be the controlling component in the HVAC support design (i.e., the anchor bolts have the least design margin). Anchor bolts are designed with a margin of safety of four to its ultimate tensile load capacity as published in manufacturers' catalogs. The ultimate tensile load capacity is based on the failure of the anchor bolt in concrete due to static loadings. IE Bulletin 79-02 also accounts for bolt slippage in its safety factor of four. Thus, the staff concludes that although the expansion anchor bolts have the least design margin to the allowable design load, there is a design margin of at least 4.0 to the anchor bolt failure due to static loads.

To provide additional verification of the accuracy of the catalog data presented by the anchor bolt manufacturers, Teledyne Engineering Services (TES) has performed both experimental and analytical work on anchor bolts made by different manufacturers including Hilti and Phillips[6]. This work was done for a group of 14 utilities, in response to IE Bulletin 79-02. The TES report is discussed in detail in Appendix B of NUREG/CR-2137. The TES test data for Hilti and Phillips wedge anchors showed relatively close correlation with the catalog loads. The maximum ratio of catalog loads to TES average test loads for Hilti and Phillips was 1.3.

The available test data[(6)] indicates that by using a safety factor of four to the average strength of the expansion bolt, the probability of failure at the design load is less than 0.001. The probability of failure at two times the design load is about 0.023[(7)].

The ultimate strength of drilled-in concrete expansion anchor bolts for dynamic and vibratory loadings was investigated by the staff. The safety factor of four as recommended by anchor bolts manufacturers is applicable to static loadings. The design margin to failure for seismic loadings which are dynamic and vibratory in nature is a function of both load magnitude and the number of cycles. A report on an investigation by Bechtel Power Corporation to justify the use of expansion anchor bolts in the Fast Flux Test Facility (Richland, Washington) was prepared for the Hanford Engineering Development Laboratory in January 1975.[8] The objective of this investigation was to establish the allowable design loads (tension, shear, and combined load) for expansion bolts to be installed in various mixes of concrete. The test loads included static loads and alternating loads which simulated the dynamic earthquake loads. The expansion bolts included the stud type wedge anchors manufactured by Hilti Fastening Systems. The seismic loading was simulated by about 6000 cycles of a sine wave which varied from zero to 0.2S (where S is the static load capacity of the anchor bolt). The test found that all expansion bolts which were tested successfully withstood 6000 cycles of 0 to 0.2 S alternating load as designated for seismic qualification. The dynamic load capacities of the expansion bolts were found to be the same as their corresponding static load capacity. It was further discovered that at 6000 to 7800 load cycles when the dynamic test load sequence was increased to 0.6 S subsequent alternating loading caused appreciable wedge movement (or "walking"). If the bolt did not fail in a brittle mode due to pull-out or in some other premature failure mode (e.g., poor installation), the "walking" ceased after a certain number of load cycles.

Extensive dynamic testing of expansion anchor bolts was also discussed in NUREG/CR-2999[9] by Hanford Engineering Development Laboratory under contract with the NRC. Prior to the testing, a survey was performed to determine the adequacy of existing concrete expansion anchor test data. Based on the survey findings, it was concluded that there was a lack of testing to assess the effect of bolt preload under dynamic loadings. Thus, exploratory dynamic testing was performed on typical wedge and shell anchors. It was found that, when the installation torque is properly applied, residual preload does not significantly affect anchor load displacement characteristics until the preload drops to less than 50% of the full installation preload. It was concluded that this must be considered in design situations where support stiffness is an important factor. Table 8 presents the dynamic test results for typical wedge anchor bolts. It can be seen from the ultimate dynamic load capacity and the number of cycles to failure, that there is a large design margin (a minimum of 2.4 for test number DW-SR). The number of cycles exceeds the number of seismic cycles recommended in the Standard Review Plan (10 SSE and 50 OBE) by approximately a factor of three. It should be noted that 3 out of 20 tests did experience 1/4 inch bolt pullout at a load less than the static design load (which is based on a safety factor of four). The 1/4 inch pullout occurred at approximately 80 percent of the static design load.

Thus, the staff finds that the dynamic testing performed by Bechtel and Hanford Engineering Development Laboratory provide similar results. Both testing results appear to indicate that a safety factor of four for dynamic vibratory loads is adequate for the number of peak cycles associated with seismic events, and that the ultimate anchorage capacity is not completely lost although some degree of bolt slippage might occur. Thus, the staff concludes that based on the dynamic testing discussed above, the wedge-type expansion anchor bolt when designed with a safety factor of four to the static anchor capacity and when properly installed is capable of withstanding the dynamic loads associated with a design basis seismic event.

The staff discussed the effect of the prying action of the support baseplates on the anchor bolts. The applicant does not account for prying effects in its anchor bolt design for non-piping supports. The AISC, ACI-318, and ACI-349 criteria do not address the prying action of baseplates on bolt loads. However, ACI and AISC do address the steel-to-steel prying action. Bechtel concluded that because the concrete is relatively soft compared to steel, the effects of the baseplate prying action will be small. In addition, Bechtel believes that the slippage of the bolt does not degrade the ultimate anchorage capacity. The staff review of responses to IE Bulleting 79-02 found similar conclusions. A test report summary by Sargent & Lundy[10] found that for a flexible baseplate with four expansion anchors, the prying action is of the order of 15-20 percent of the applied load. The S&L report also concluded that the small increase was much lower than the expected increase in an assembly with embedded steel bolts where the prying action was calculated to be 110 percent because of the effective lower stiffness of expansion anchors in concrete. Thus, based on the consistency in the results of the prying action of baseplates on concrete anchor bolts as discussed above, the staff concludes that the prying action will not cause a significant increase in the expansion bolt loads.

With regards to the use of lesser grade materials, the staff believes that it is unlikely that material substitution is a significant concern for expansion anchor bolts because of their unique application and configuration. Use of low strength bolts or bolts made of poor quality materials would likely become evident during bolt installation when the bolt preload torque is applied. A low-strength or poor quality bolt would likely yield or break before the required preload torque could be achieved. If an expansion anchor bolt were made with a substitute material of a lesser quality (e.g., A307 material) and remained undetected following application of the preload, nigh shear strengths given in the manufacturer's catalogs could be unconservative. However, the staff believes that the safety factor of four when applied to the manufacturer's ultimate shear loads provides an adequate margin of safety to account for substitute materials. The ultimate a hor pullout load is not likely to be affected because the ultimate anchor llout load is in all cases less than the tensile requirements for A307 bolts.

A comparison of the bolt preload values with ASTM A307 tensile strength requirements is shown in Table 9. The staff has found that use of lesser grade materials could be a potential concern with the ITT Phillips Wedge Anchors (7/8 inch diameter only). ITT Phillips supplies both a nuclear grade and a non-nuclear (commercial) grade expansion anchor bolt. For Midland, the procurement specification specifies an NWS-7880 (nuclear grade) wedge anchor. The difference in the nuclear grade and the non-nuclear grade bolts is in material and traceability. The nuclear grade bolt material is AISI 1144 grade with an average tensile strength of 100-120 ksi and a yield strength of 90-110 ksi. The nuclear grade is stamped "NWS" and has a "gold" chromate finish. The commercial grade bolt is 1213 to 1215 carbon steel (no traceability) with a tensile strength of 80-95 ksi and a yield strength of 70-80 ksi. The commercial grade is stamped "WS" and has a silver finish. In accordance with the manufacturer's recommendations, the nuclear grade bolt for 7/8 inch diameter has a pullout ultimate load capacity of 14 ksi (vs 11.85 ksi for commercial) and a shear capacity of 22.5 ksi through the threads and 30.0 ksi through the shank (vs. 24.9 ksi for commercial). Thus, the use of a commercial grade bolt instead of a nuclear grade bolt could reduce the design capacity by 15-20 percent. Based on a review of the dynamic test data, the staff concludes that a reduction of 15-20 percent of the anchor capacity, or in equivalent terms, a reduction of the safety factor from 4.0 to 3.2 appears to be acceptable.

V. Conclusions

A significant effort has been expended by the staff on the subject of expansion anchor bolts largely because of the many uncertainties involved in the actual strength of the installed anchor bolt. The conclusions of the tests, performed on the expansion bolts were based on properly installed bolts and under controlled loadings. Some uncertainties which could affect the overall findings of the staff include 1) improperly installed expansion anchor bolts, 2) the dynamic effects of a seismic event on the anchorage capacity of floors and walls in which the expansion anchor bolts are installed, 3) the long-term aging effects on the anchor strength, and 4) the uncertainties in the dynamic loadings itself. The staff has found that the most limiting component in the HVAC structural design is the expansion anchor bolt assembly. Although the factor of safety used in the design of the anchor bolt capacity appears to be adequate to account for the static and dynamic loads associated with normal and design basis accidents, there is some degree of uncertainty involved with as-installed expansion anchor bolts and the actual loading conditions which could occur that remain as potential concerns of the staff. These concerns extend beyond the scope of this evaluation and into the areas identified above where further generic development should be performed. Thus, our findings on the design margins do not take into account the above uncertainties, except in a qualitative manner.

Based on a detailed review of the typical design margins available in the structural design of the HVAC ductwork and supports, the staff has concluded that there is an adequate margin between the stress or load level that would result under normal and design basis accident conditions and the stress or load level that would result in structural failure of the HVAC ductwork and support systems. The staff further concludes that the available design margin provides adequate compensation for potential degradations in the structural integrity that could result from substitution of lesser quality or lesser grade materials. Therefore, the staff finds that the overall structural design of the Midland HVAC systems is adequate and provides a sufficient margin of safety to failure under normal and design basis accident conditions.

VI. References

1) "Technical Specification for Seismic Class I Heating, Ventilating and Air Conditioning Equipment and Ductwork Installation," for the Midland Plant Units 1 & 2, 7220-M-151A(Q), Rev. 15.

2) "Design Guide for HVAC Supports," (DRAFT) Calc. No. 3471(Q).

3) "Design Guide for Nuclear Power Plant Seismic Category I Rectangular HVAC Ducts (DRAFT)," dated April 15, 1978.

4) "Report on Testing of Class I Seismic HVAC Duct Specimens for the Limerick Generating Station, Units 1 & 2," April 1976.

5) Calculation No. 34-323(Q), Revision 0, dated 10-11-83.

6) Teledyne Engineering Service, Summary Report, "Generic Response to USNRC I&E Bulletin Number 79-02, Base Plate/Concrete Expansion Anchor Bolts," August 1979.

7) NUREG/CR-2137, "Realistic Seismic Design Margins of Pumps, Valves, and Piping," June 1981.

8) FFTF Report, "Drilled-in Expansion Bolts Under Static and Alternating Load," January 1975 (BR-5853-C-4).

9) "Final Report USNRC Anchor Bolt Study Data Survey And Dynamic Testing," NUREG/CR-2999, dated December 1982.

10) Sargent & Lundy report, "Summary Report on Static and Dynamic Relaxation Testing on Expansion Anchors in Response to I&E Bulletin 79-02," dated July 20, 1981.

Table 1

HVAC Support Material

ASTM Material Specification	ASTM Minimum Yield Strength (ksi)	ASTM Minimum Tensile Strength (ksi)	M-151 Minimum Yield Strength (ksi)	Notes
A 36	36	58-80	same as ASTM	
A 572 Gr. 50	50	65	same as ASTM	
A 284 Gr. A	25	50	same as ASTM	plate
A 500 Gr. B	46	58	same as ASTM	tube steel
A 575 (M1020)	not required	not required	36	angle

Table 2

HVAC Support Material Properties (A575)

ASTM-A575	Minimum Yield Strength (ksi)
Grade M1008	34.0
Grade M1010	35.7
Grade M1015	36.1
Grade M1020	37.2

Table 3

HVAC SUPPORTS

Tabulation of Calculated vs. Allowable Stress

Location	Reference Calc. No.	Description [1]	Calculated Stress / Allowable Stress	Design Margin
Control Room	21 G (4.4143)	W 6 x 12	0.23	4.3
		L 3 x 3 x ¼	0.19	5.3
		L 2 x 2 x ¼	0.13	7.7
		L 2 x 2 x ¼	0.13	7.7
		L 3½ x 3½ x ¼	0.05	20.0
		weld	0.76	1.3
		weld	0.10	10.0
		weld	0.61	1.6
		weld	0.51	2.0
Control Room	21 G (4.146)	all structural members	0.48	2.1
		weld	0.03	33.3
		anchor bolt	0.50	2.0
Control Room	29 D 276	L 3 x 3 x ¼ (all)	0.33	3.0
		W 6 x 12	0.04	25.0
		TS 2 x 2 x ¼	0.04	25.0
		weld	0.42	2.4
		weld	0.73	1.4
		weld	0.57	1.8
Service Water Bldg	648-S126	TS 3 x 3 x ¼	0.15	6.7
		TS 2 x 2 x ¼	0.09	11.1
		L 2 x 2 x ¼	0.13	7.7
		weld	0.03	33.3
		weld	0.12	8.3
		weld	0.68	1.5
		weld	0.06	16.7
		weld	0.35	2.9
		anchor bolt	0.40	2.5
		anchor bolt	0.88	1.1
		anchor bolt	0.64	1.6
		anchor bolt	0.80	1.3
Auxiliary Bldg	21 F (3.136)	L 2 x 2 x ¼	0.13	7.7
		TS 2 x 2 x ¼	0.14	7.1
		weld	0.04	25.0
		weld	0.20	5.0
		weld	0.15	6.7
		weld	0.04	25.0
		anchor bolt	0.58	1.7
		anchor bolt	0.34	2.9

Table 3 (continued)

Location	Reference Calc. No.	Description [1]	Calculated Stress / Allowable Stress	Design Margin
Auxiliary Bldg	21 I (6.95)	TS 4 x 4 x ¼	0.32	3.1
		TS 2 x 2 x ¼	0.48	2.1
		L 2 x 2 x ¼	0.36	2.8
		PL ½ x 18	0.13	7.7
		weld	0.40	2.5
		weld	0.35	2.9
		weld	0.15	6.7
		weld	0.24	4.2
		weld	0.29	3.4
		weld	0.25	4.0
		weld	0.10	10.0
		weld	0.23	4.3
		weld	0.32	3.1
		L 4 x 4 x ½	0.44 (shear controlling)	2.3

1 W = wide flange
L = angle
TS = tube steel
PL = plate

Table 4

HVAC Ductwork Material

ASTM Material Specification	ASTM Minimum Yield Strength (ksi)	ASTM Minimum Tensile Strength (ksi)	M-151 Minimum Yield Strength (ksi)
A526	not required	not required	30
A526	not required	not required	30
A366	not required	not required	30
A607 Gr. 50	50	65	same as ASTM
A240 Type 304	30	75	same as ASTM

Table 5

Summary of HVAC Duct Analysis Results[3]

Duct Size (inches)[1]	Sheet Metal Gauge	Stiffener[4]	Allowable Pressure (psi) Sheet Metal	Allowable Pressure (psi) Stiffener	Governing Allowable Pressure (psi)	Calculated Worst Loading (psi)[2]	Design Margin
Control Room (Aux Bldg)							
60x26	18	L2x2x3/16	0.86	0.69	0.69	0.294	2.35
36x26	16	L1½x1½x1/8	1.40	1.40	1.40	0.301	4.65
Diesel Generator Bldg							
60x60	16	L2x2x3/16	1.086	0.691	0.69	0.253	2.73
30x40	16	L1½x1½x1/8	1.322	1.40	1.32	0.253	5.22
Service Water Pump Structure							
72x44	16	L3x3x3/16	1.064	1.102	1.102	0.230	4.79
72x24	18	L3x3x3/16	0.865	1.102	0.865	0.223	3.88
52x44	16	L2x2x1/16	1.237	0.98	0.98	0.230	4.26
42x26	18	L1½x1½x1/8	1.111	0.94	0.94	0.223	4.22
28x26	18	L1½x1½x1/8	1.408	1.04	1.04	0.223	4.66
Auxiliary Building							
108x16	14	C 3x5.0	1.14	0.47	0.47	0.335	1.40
108x16	14	C 5x6.7	1.14	1.25	1.14	0.628	1.75
60x32	18	L2x2x3/16	1.15	0.69	0.69	0.326	2.12
38x38	16	L1½x1½x3/16	1.44	1.22	1.22	0.330	3.70
76x40	16	L3x3x3/16	1.04	0.97	0.97	0.254	3.82
50x40	16	L2x2x3/16	1.25	1.08	1.08	0.259	4.17
54x36	18	L2x2x3/16	0.98	0.89	0.89	0.320	2.78
28x14	18	L1x1x1/8	1.41	1.05	1.05	0.234	4.49
24x24	18	L1x1x1/8	1.56	1.59	1.56	0.223	7.00
12x6	18	L1x1x1/8	2.59	11.10	2.59	0.234	11.07
60x36	16	L3x3x3/16	1.15	1.70	1.15	0.593	1.94

(1) Largest duct size for the same gauge sheet metal and stiffener.

(2) Worse case loading is Dead Load + P + W, where P = operating pressure, W = wind load. The worst case loading bounds seismic load combinations.

(3) Summary of results from Bechtel Calc. No. SQ-180(q) dated 5/16/83. Stresses due to dead load, seismic load, wind and internal pressures are converted to equivalent internal pressure loads for comparison.

(4) L = angle
C = channel

Table 6

Table of HVAC Duct Flange Bolt Loads

Duct Size (in)	Sheet Thickness (gauge)	Operating Pressure in W.G. (in)	Forces in Bolt @ Safe Shutdown Earthquake: Max. Tension In Bolt of Companion Flange (lb)	Allowable Tension (lb)	Max. Calculated Load / Allowable Load	Design Margin
60 x 26	16	13	1200	2340	0.51	1.96
60 x 60	14	13	1900	2340	0.81	1.23
30 x 30	18	13	586	2340	0.25	4.00
60 x 60	16	4	840	2340	0.36	2.78

Table 7

Concrete Expansion Anchor Bolt Material Properties

Type	Size (inches)	Material Properties	Requirements Met
Stud (bolt)	1/4-1/2	AISI 11L41	ASTM A108
	5/8-1¼	AISI 1144	ASTM A108
Expansion Wedges		ANSI 1050 spring steel	
Nuts		commercial manufacture	ASTM A307
Washers		SAE material	ASA B27.2-1949

Table 8
Dynamic Test Results (From Reference 9)

Test No.	Anchor Type	Load Type	Ultimate Static Strength (Kips)	Preload**	Test Results: No. of Cycles	Test Results: Ult. Load Kips	Test Results: Note	Test Results: Load at 1/4" Displ. Kips
DW-1	Wedge	Tension	(25.3)	Full	845	25.3	1, 2	15.2
DW-1R				Full	141	20.2	1, 2	15.2
DW-2				Full	255	25.3	1, 2	10.1
DW-3				Half	239	25.3	1, 2	15.2
DW-4				Half	181	25.3	1, 2	10.2
DW-5				Zero	133	20.2	2, 3	5.0
DW-5R				Zero	105	15.2	2, 3	5.0
DW-6				Zero	179	25.3	2, 3	10.2
DW-7		Shear	(24.0)	Full	208	28.8	2, 4	24.0
DW-8				Full	179	24.0	2, 4	14.4
DW-9				Half	176	24.0	2, 4	14.4
DW-10				Half	165	24.0	2, 4	14.4
DW-11				Zero	163	24.0	2, 4	14.4
DW-12				Zero	167	24.0	2, 4	14.4
DW-13		Combined*		Full	161	25.3	2, 5	10.1
DW-14				Full	135	20.2	2, 5	15.2
DW-15				Half	139	20.2	2, 4	5.0
DW-16				Half	161	25.3	2, 4	10.1
DW-17				Zero	161	25.3	2, 4	15.2
DW-18				Zero	140	20.2	2, 4	15.2

* $\frac{\text{Tension}}{\text{Shear}} = 1.732$

** Full preload: 125-175 foot-pounds
Half preload: 62-88 foot-pounds
Zero preload: Finger tight

NOTES
1. Anchor pullout, no concrete failure
2. Test stopped at 1" displacement
3. Anchor pullout and local concrete failure
4. Anchor shear failure
5. Anchor shear and local concrete failure

Table 9

Comparison of Anchor Bolt Load Requirements

Bolt Diameter (in)	Minimum Preload Torque (ft-lbs)[(a)]	Minimum Anchor Bolt Preload (lbs)[(b)]	Ultimate Anchor Pullout Load Capacity (lbs)[(c)]	A307 Bolt Requirement for Tensile Strength (lbs)[(d)]
1/2	35	2,800	5,510	8,500
5/8	130	8,320	9,100	13,550
3/4	240	12,800	13,400	20,050
7/8	275	12,571	14,000	27,700
1	425	17,000	18,900	36,350

(a) per Specification 7220-C-305(Q) Rev. 17

(b) Calculated using the equation:

$$T = KDL$$

where: T = preload torque applied
K = assume 0.3 for unlubricated threads
D = nominal bolt diameter
L = bolt preload force

(c) per Hilti Fastening Systems and ITT Phillips Drill Company Catalogs
Based on 3500-4000 psi strength concrete

(d) per ASTM Specification, "Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners," A307-76b.

ENCLOSURE 2

EVALUATION OF FUNCTIONAL DESIGN

ADEQUACY OF MIDLAND HVAC SYSTEMS

The Midland heating, ventilation and air conditioning (HVAC) systems consist of various individual systems, each of which is designed to maintain the specific building or area within certain limits required for habitability and/or equipment operability. A description of the function of each of these systems and areas that each system serves is provided in Section 9.4 of the Midland SER (NUREG-0793, May 1982).

In support of the review of the structural design adequacy of the HVAC systems at the Midland Plant, the staff also reviewed the functional design adequacy of the ventilation systems. The objective of this review was to verify that the conclusions reached by the staff in Section 9.4 of the Midland SER continue to be valid for the actual ventilation system design at Midland.

In performing its review, the staff reviewed the latest revisions to drawings of the Midland ventilation systems and compared them with earlier drawing revisions upon which the staff's FSAR review had been based. The staff concluded that there were no design changes that would alter the conclusions reached in the SER based on the later drawings.

A particular focus of the drawing review was on any changes to transition points and isolation capabilities between safety related and non-safety related portions of the systems from those described in the FSAR and the SER. This portion of the review was in support of the structural design adequacy evaluation (i.e., if the safety-related boundaries had changed from those reviewed in the FSAR, then the structural design adequacy review would need to determine whether or not those changes had been taken into account in the design of the structural supports.) The staff concluded that the transition points and isolation capabilities between safety related and non-safety related portions of the ventilation systems remained as described in the FSAR and SER.

Based on its review of the functional aspects of the present ventilation systems design at Midland, the staff determined that the evaluations and the conclusions reached in Section 9.4 of the Midland SER remain valid. Verification of the HVAC systems fuctional capability to meet the design requirements will be performed during the intial testing program as described in FSAR Section 14A.

ENCLOSURE 3

EVALUATION OF MIDLAND HVAC MATERIALS

The specifications and records for materials of the Midland HVAC systems were audited October 6-7, 1983. The purpose of the review and audit was to verify that the materials incorporated into the construction met the requirements called out in the design and procurement documents.

The identification of materials for use in the Midland HVAC systems is contained in Bechtel Technical Specification 7220-M-151A(Q), "Seismic Class 1 Heating Ventilation and Air Conditioning Equipment and Ductwork Installation for the Consumers Power Company, Midland Plant Units 1 and 2, Midland, Michigan."

It is the applicant's practice to revise this Specification during construction by incorporating into the Specification those deviations that were considered to be acceptable. These deviations were originally accepted by QC documents such as Supplier Deviation Deficiency Requests (SDDRs), Specification Change Notices (SCNs), and Field Change Requests (FCRs). Although the practice of incorporating these deviations in the Specification reduces the amount of repetitive paper work required, the practice tends to degrade the original Specification. It also means that an audit of QA records will show that all accepted material met the Specification.

An extensive sample of the procurement packages for HVAC materials was reviewed during the audit. No discrepancies were found in the system. Some of the dates of certification were observed to be retroactive, but no indication was found that nonconforming material had been installed.

As noted in Franklin Research Center's Report F-C5896-001, samples of material taken from the actual duct work installed at the site or from storage were tested. The intent was to determine if the material samples met the specifications for chemical analysis and relevant material properties. Although the chemical analyses and mechanical property tests performed did not reflect the specification requirements in all cases, the only discrepancy found of potential significance was that some of the bolts were harder than permitted by the Specification. The potential problem associated with bolts of higher than specified hardness is that if torqued to high stress levels, they can be susceptible to stress corrosion cracking. Upon further review, however, we find that the threshhold hardness for susceptability to stress corrosion failure is significantly greater than the hardnesses exhibited by the Midland bolt samples. Thus, failure of the Midland HVAC bolts due to stress corrosion cracking is unlikely.

In summary, this investigation did not disclose any materials discrepancies that would be expected to cause operating problems with the HVAC system as installed at Midland, although some of the installed material was apparently not in compliance with the appropriate specification.