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May 8, 1997

Dr. Shirley Ann Jackson
Chairman
Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD, 20852

Dear Chairman Jackson:

I am writing in regard to evidence suggesting that RTV silicone foam, used as fire barriers in U.S. nuclear reactors, is both highly combustible and prone to installation problems which render it ineffective. I understand that the NRC has been aware of the generic combustibility and installation problems associated with the widespread use of this material since 1979, and am concerned that the Commission may not have responded to this problem with sufficient urgency. In fact, it is my understanding that the NRC may be planning to **remove** the non-combustibility requirement associated with the very materials that are intended to prevent fires from spreading.

The January, 1991 NRC report entitled "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (NUREG-1150) states that "it has been observed that typical nuclear power plants will have three to four significant fires over their operating lifetime." Moreover, NRC's probabilistic risk assessments indicate that fires contribute anywhere from 7-50% of the total core damage frequency in nuclear reactors. The U.S. Code of Federal Regulations (10 CFR 50 Appendix R Section III Subpart M) clearly states that "Penetration seal designs shall utilize only non-combustible materials and shall be qualified by tests that are comparable to tests used to rate fire barriers."

However, an NRC technical assessment document released in 1996 concludes that "there is no basis for the criteria "that specifies that penetration seal materials be non-combustible."

In light of the potential risk to public health and safety that could result from a catastrophic fire at a nuclear power plant, I find the NRC's failure to implement strong fire safety regulations that are fully protective of the public to be simply inexcusable. Moreover, I am troubled to hear that the NRC's response to the charge that the fire barrier materials that are currently in use are inadequate may be to relax its regulations and **allow** highly combustible materials to be used as fire barriers.

In order to better understand the basis for the Commission's activities in this area, I request your assistance in responding to the following questions:

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Combustibility of RTV Silicone Foam Penetration Seals

Following the Brown's Ferry accident in 1975, when a fire was started in a cable penetration seal consisting of flammable polyurethane foam and 'Flamemastic' coating, RTV silicone foam began to be used as a fire barrier material in fire-resistance rated wall and floor assemblies in most U.S. nuclear power plants. Both a video and extensive documentation made available to my office suggest that RTV silicone foam poses a major fire hazard rather than providing fire protection.

1) What steps is the NRC taking to ensure removal, replacement or backfitting of RTV silicone foam penetration seals to alleviate the potential risks associated with the presence of this substance in the U.S. nuclear generating stations? If no steps are being taken, please justify.

2) Subsequent to the Brown's Ferry fire in 1975 involving combustible penetration seal materials (polyurethane foam), the NRC Annual Report for 1975 reported that:

> The flexible polyurethane foam sealing material being used had not been specifically approved by the licensee's design department, nor had it been tested for this kind of application. The dangers involved in using flammable material in this manner were evidently not recognized by plant management, even though several small fires had occurred during similar testing activities.

The NRC then promulgated the 10 CFR 50 Appendix R fire protection program for nuclear power stations. The fire barrier cable penetration seal qualification listed in Section III Subpart M states that "Penetration seal designs shall utilize only non-combustible materials and shall be qualified by tests that are comparable to tests used to rate fire barriers." NRC's Technical Assessment of Fire Barrier Penetration Seals in Nuclear Power Plants, SECY-96-146, July 1, 1996, acknowledges that Dow Corning RTV silicone foam, when tested by the appropriate combustibility protocol (ASTM E-136), is classified as a combustible material.

a) Please provide copies of the ASTM E-136 combustibility tests that the NRC refers to in its July 1, 1996 SECY- 96-146.

b) In spite of the finding that RTV silicone foam is classified as a combustible material, the report concludes that NRC staff "found neither plant-specific problems nor generic problems of a safety significance." Section 5.4 of the technical report details the staff's review of fire penetration seal programs at several reactors. In 1987, the Wolf Creek Generating Station reported that it had to repair approximately 35% of its 1700 silicone foam penetration seals. In 1993, the Vermont Yankee reactor had to repair or upgrade approximately 85% of their 1400 fire barrier penetrations. In April, 1997, the Maine Yankee nuclear power station determined that 90% of its 2600 penetration seals were

defective as the result of installation problems. What is the NRC's definition of a "generic" problem and a "plant-specific" problem?

c) Why wouldn't the aforementioned examples constitute evidence of a generic or plant specific problem?

3) The Executive Summary of the technical report attached to the SECY 96-146 paper states that "fire barriers offer reasonable assurance that a fire will not spread from one plant area to another." The NUREG-1150 risk assessments assume that silicone foam fire penetration seals prevent fires from spreading from one plant area to another when estimating its 7-50% core damage frequency resulting from fires in nuclear plants.

a) Given the high percentage of fire barrier penetrations seals that were found to be defective at the Wolf Creek, Vermont Yankee and Maine Yankee reactors, would you agree that **i)** the assumption that the fire barrier penetration seals will prevent fire from spreading from one plant area to the other is invalid and **ii)** that the 7-50% core damage frequency estimate is an underestimate? If not, why not?

b) What is the core damage frequency estimate if it is not assumed that as much as 90% of the fire barrier penetration seals will prevent fire from spreading from one plant area to the other?

4) Page 2 of the Executive Summary states that fire barrier penetration seals are "universally accepted building components." Why did the NRC fail to mention that combustible silicone foam penetration seals are forbidden in German nuclear power plants for safety reasons?

5) In light of the significantly high contribution by fire to the overall risk of a core melt accident and evidence of repeated chronic problems with deficient and combustible RTV silicone foam seals identified in 1979, please justify the slow approach that the NRC has taken towards resolving this fire protection issue.

6) Finding 10 of Section 6 of the technical report attached to the SECY paper states that there "is no basis for the criteria in Appendix R and the SRP [Standard Review Plan] that specifies that penetration seal materials be non-combustible." Why does the NRC say there is no basis for specifying a non-combustibility requirement for materials whose sole function in nuclear power plants is to act as a fire barrier? Please justify your response.

7) The NRC annual report (1975) reviews the March 22, 1975 fire in electrical cable trays at the Browns Ferry Nuclear Plant. The fire started in an electrical cable penetration between the cable spreading room and the reactor building when a candle flame used by a construction worker for checking air leaks ignited the cable penetration sealing material. The NRC clearly states with regard to the use of combustible polyurethane foam at Browns Ferry that "The dangers involved in using flammable material in this manner were evidently not recognized by plant management."

In issuing NRC Information Notice (IN) No. 88-04 Supplement 1, the Commission acknowledged that as early as August 9, 1979, as a result of several fires at the Diablo Canyon nuclear power station and the Davis Besse nuclear power station involving the ignition of the Dow Corning product in penetration seals, the agency was aware that RTV silicone foam was combustible and constituted a non-compliance issue with 10 CFR 50 Appendix R section III Subpart M. As was illustrated by a number of separate fire events at Diablo Canyon, the silicone foam repeatedly ignited from contact with the exhaust pipe from the diesel generators. The fire was described as involving "dense smoke and two to three foot flames coming from the penetration seal material."

The Information Notice further states that the "present notice is being issued separately to highlight the potential misapplication of silicone foam sealant material for uses in which the sealant must withstand significant exposure to high temperature."

IN 88-04 Supplement 1 goes on to state that "suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required."

a) What justification or criteria did the agency rely upon to waive licensee compliance with the non-combustibility requirement for materials used in fire barrier penetration seal designs as specified in 10 CFR 50 Appendix R section III Subpart M? Please provide justification of why the NRC did not take any enforcement action.

b) After learning that both Thermo-Lag fire barrier wrap systems and silicone foam material in penetration seals are highly combustible, has the NRC required the licensees to include the combustibility of the products in their combustible loading analysis? If not, why not?

c) Has NRC conducted or reviewed calorimetric tests of the contribution from burning RTV silicone foam penetration seals involved in a nuclear power station fire? If so, please provide copies of all test reports.

d) Other than RTV silicone foam internal thermocouple readings of the ULC test on October 1, 1996 in Canada, what data is now in the possession of the NRC that quantifies the combustibility and fire behavior of RTV silicone foam? Please provide copies.

8) After it was determined that silicone foam fire testing data had been lost in a fire, Brand Industrial Services, Inc. (BISCO) a fire barrier vendor, re-tested their nine-inch silicone foam penetration seal design. The design reportedly failed the three hour fire endurance test. It is my understanding that this particular seal design has never passed the three hour fire endurance test in the U.S. Tests on similar designs conducted in Europe have reportedly failed in less than 90 minutes, which is less than half the minimum fire endurance requirement in the U.S. as tested to the same time/temperature curve used in the U.S. Notwithstanding these problems, this particular design is reportedly installed in 56 nuclear power stations in the U.S. In a letter dated April 18, 1990, BISCO requested a letter of

support for this seal design from the NRC for the purposes of vendor sales to the South Korean nuclear power industry. NRC responded by providing BISCO with a May 16, 1990 letter which seems to endorse and promote the use of the RTV silicone foam product for use within the South Korean nuclear power industry.

a) Can NRC provide justification for the extensive sales and application of RTV silicone foam throughout the nuclear power industry as fire barrier penetration seals without apparent agency oversight or a verification process to determine that licensees were qualifying the Dow Corning material as non-combustible per requirement of 10 CFR 50 Appendix R Section III Subpart M?

b) On what basis does the NRC allow the untested nine inch silicone foam penetration seal design to exist in nuclear power stations?

c) Can NRC provide justification for the agency's further assistance to BISCO's marketing effort to South Korea?

d) Why hasn't the NRC followed up and determined if the licensees who are using the nine inch silicone foam system have properly repaired the defective design?

e) Why was there no enforcement action taken against the vendor and the utilities who knew of the problem as stated yet never corrected it?

f) Why has the NRC staff neglected the draft Information Notice 88-XXX design details and opted to ignore detailed staff guidance for fire penetration seals?

g) When is the NRC planning to enforce its finding of BISCO's sealing system lacking proper fire tests and ensure that the utilities relying on this untested design have remedied the problem?

9) The Nuclear Information and Resource Service (NIRS) raised concerns regarding RTV silicone foam as one issue in the technical review and safety evaluation of the Watts Bar startup program in a letter dated October 26, 1995. In response to these concerns, a letter from Mr. Conrad McCracken, Chief, Plant Systems Branch, Division of Systems Safety and Analysis, Office of Nuclear Reactor Regulation, dated December 12, 1995 acknowledged that silicone foam seal materials are combustible as defined by NRC fire protection guidance. NRC recognized that RTV silicone foam has a high-temperature stability, flexibility and resistance to the effects of radiation exposure and aging. NRC concluded that properly configured, installed and maintained RTV silicone foam fire barrier protection seals provide an adequate level of fire protection and therefore "the use of silicone foam and silicone elastomer is an acceptable deviation from the penetration seal guidance of NUREG-0800."

However, the NRC response does not provide a single reference to 10 CFR 50 Appendix R Section III Subpart M, which states that fire barrier penetration seal designs shall utilize only non-combustible materials.

a) What criteria did NRC use to qualify the use of combustible RTV silicone foam as an "acceptable deviation" from 10 CFR 50 Appendix R Section III Subpart M?

b) How does NRC define "acceptable deviation" with regard to fire protection safety?

Penetration Seal Installation Problems

NRC documentation in NUREG-1552 identifies that a typical nuclear power unit can have as many as 10,000 penetration seals installed throughout the nuclear power station. NRC documentation in SECY-96-146 describes a review of reactor operating experience with RTV silicone foam that found that licensees for about 20 reactors had submitted a total of 141 Licensee Event Reports (LERs) related to problems with fire barrier penetration seals between 1989 and 1993. The review identified that 58% of the LERs regarded "Seal inoperable or deficient due to improper installation, degradation or seal breach."

An additional 26% of the LERs involved instances in which a "Seal [was] not installed or missing." Consequently, a total of 84% of the associated problems with fire barrier penetration seals were related to installation problems. The NRC has also issued several Information Notices (INs) regarding silicone foam problems. IN 88-56, entitled "Potential Problems with Silicone Foam Fire Barrier Penetration Seals" dated August 4, 1988, documents that potential installation problems involving voids, gaps and splits in fire barrier penetration seals could result in the reduction of the fire resistive capabilities for protection of safety-related redundant equipment and electrical power and control circuits.

1) What, in the NRC's view, do these findings mean for the presumed aging stability of RTV silicone foam?

2) I have also been made aware of additional information documenting the installation problems of RTV silicone foam provided by the Underwriters' Laboratories of Canada. Their independent tests encountered installation problems potentially resulting in faulty firestops which include large voids in the seals, splitting, fissures and shearing of the seal during the expansion phase of installation of RTV silicone foam, as well as gapping of the material, shrinkage and hydrogen gas leakage from the seals. NRC acknowledged in IN 88-56 that because penetration seals are often hidden by permanent ceramic shields, defective seals are not obvious or easily inspectable.

a) What assurances can NRC provide that inadequate fire barrier penetration seal configurations involving exposed or unprotected RTV foam seals have been identified by licensee inspections?

b) Is the NRC capable of estimating what percentage of fire barrier penetration seals are inaccessible to inspections? If so, please provide the estimation of this percentage as well as the rationale used by NRC to reach it.

c) Given the difficulties involved in inspecting installed seals, what will the NRC do to ensure that firestops have been properly tested, monitored and inspected?

d) A March 9, 1990 NRC communication to the Wolf Creek Nuclear Operating Corporation states that the NRC Office of Investigations "determined that the problem with the seals uncovered at the Wolf Creek Nuclear Generating station is a generic one, inherent both in the material and in the cable tie inspection method utilized at the time of the installation of the seals."

In addition, the communication states that there "is a potential for similar problems at any nuclear plant that utilized silicone foam seals and the cable tie method of inspection, regardless of the installer." In light of the numerous reported problems with both the installation and combustibility of RTV silicone foam, why hasn't the NRC issued a Generic Letter identifying the generic problems and requiring action on behalf of all the affected licensees?

e) What types of enforcement action does NRC plan to take against licensees who have been repeatedly warned of RTV silicone foam firestop deficiencies since 1988 but have not yet taken remedial action?

Fire Fighting Protocol

It is my understanding that on November 6, 1995, Mr. Gerald Brown, a fire safety consultant, initiated contact with the NRC Region 3 Office of Investigations, which filed a formal allegation. Mr. Brown charged that when silicone foam burns it leaves a solid, hard char on the surface as the fire propagates into the seal, and that in order to extinguish this fire it is necessary to remove the char in order to prevent re-ignition. It is my understanding that an October 1, 1996 test conducted by the Underwriters' Laboratories of Canada may have lent support to the substance of this allegation. In a response dated November 9, 1995, Mr. Conrad McCracken, Plant Systems Branch, Office of Nuclear Reactor Regulation confirmed that "staff agrees that silicone foam develops a solid char as the fire decomposes the penetration seal material and that a fire may become deep seated within the penetration."

The response went on to state that in the event of a significant nuclear power station fire, the station fire brigade will fight the fire in three phases: first, the knockdown and control phase, second the overall extinguishment phase where the brigade will break into all of the up to 10,000 fire barrier penetration seals involved in the fire and extinguish all fires by applying additional water to any smoldering material, and third, the brigade will post fire watches to combat any re-ignition.

1) Please provide examples of station fire fighting manuals, other training materials and training records which substantiate the implementation of this three phase technique or illustrate that fire brigades are actually being instructed on how to locate fire barrier penetration seals and tear into these seals to discover potentially deep seated fires.

2) How long would it take for fire-fighting personnel to dismantle one penetration seal?

3) How will the fire brigade find and access all affected penetration seals, many of which are inaccessible because of design and installation obstructions?

NRC Exemptions to Penetration Seal Regulations

It is my understanding that the NRC has issued some exemptions from its regulations pertaining to penetration seals. One such exemption was granted to the Pilgrim nuclear power station, allowing it to exclude required water sprinklers in the control room, based on the fact that the control room had three hour fire-resistance-rated penetration firestops. When the NRC learned that some of Pilgrim's penetration seals in the control room floor were not rated for three hours of fire resistance, and that others were so located that the bottom surface could not be inspected, the NRC issued another exemption for the plant, allowing it to use seals that were rated for less than three hours of fire-resistance.

1) On what basis did the NRC issue exemptions affecting the critically important control room sprinklers and penetration seals at the Pilgrim plant?

2) Please list all exemptions NRC has granted for penetration firestops, the reactors for which they were granted, and the basis for each exemption.

3) In 1984, the NRC Annual Planning and Program Guidance document recommended that "existing regulatory requirements that have marginal importance to safety should be eliminated." The NRC then initiated a program to identify those requirements. In 1991, NRC SECY-91-224, a communication that reported on whether any of the NRC regulations placed substantial regulatory burdens on licensees while providing only "marginal" importance to safety concluded that "no 10 CFR Part 50 regulations were identified that are so burdensome on operating reactors and so marginal to safety that would warrant the expenditure of additional staff resources to rectify [and that] no further action should be taken at this time." The report also stated that there is considerable uncertainty as to whether licensees would take advantage of the flexibility offered by non-prescriptive regulations.

a) Why did the NRC begin to consider non-prescriptive regulation in regards to fire protection only two years later?

b) Why did the NRC write a new test procedure for fire barrier envelope systems (86-10 Supplement 1) which resulted in a defined weaker hose stream test allowance (called a fog nozzle) in lieu of the stronger solid stream test previously called for in earlier test procedure, especially when the fire procedures followed by the new Watts Bar plant call for switching from the weaker fog nozzle to the stronger solid stream to ensure that the fire is out?

Model Building Code Fire Regulations

The three model building codes, respectively published by International Conference of Building Officials, Building Officials Code Administrators and Southern Building Congress International are generic codes that can be applied to all residential, commercial or industrial buildings. To examine a building code regulation, one need only consult the main index to locate the information required.

These model building codes have not been applied to construction or substantial building modifications of nuclear power generating stations. Instead, the NRC has general fire protection regulations found in the Federal Code of Regulations as 10 CFR 50:48, and has issued a number of site-specific guidance documents. In 1979, NUREG 0800 was issued in order to deal with fire barrier penetration seals. NUREG 0800 was subsequently revised in 1981.

Unlike the model building codes, there is no single NRC document that contains generic and enforceable fire protection regulations that can be applied to every existing nuclear reactor. I am concerned that the multitude of NRC documents pertaining to fire protection regulations may be contradictory and confusing, and that in some cases they lead to fire protection regulations that are actually **weaker** than those found in the aforementioned model building codes.

1) Why did NRC issue NUREG 0800 instead of utilizing model fire code regulations employed for other industrial structures?

2) How many of the current operating reactors' designs were approved by the NRC based on NUREG 0800? Please provide detailed documentation as to which plants are committed to a specific fire code regulation which can be enforced if they are out of compliance, as well as details of that code regulation for each plant.

3) If the nuclear power plants are not bound or committed to the NUREG 0800 guidance document and are not bound by the model building codes, are they, in your opinion, providing proper fire barrier code regulation compliance enforceable by your agency? Please justify your response.

4) The model building codes, which apply to all residential, commercial and industrial construction, mandate that in non-combustible (i.e. everything other than timber frame) construction, building materials must either comply with ASTM E136 by being designated as "non-combustible", or they must achieve a maximum flame-spread of 25 and fuel contribution factor of 50 in accordance with ASTM E84.

a) Please provide a spreadsheet of building materials utilized in all existing nuclear power plants and the maximum flammability regulation levied by the NRC as relevant to fire protection. Include, as a minimum, the following: Firestops, spray fireproofing, board fireproofing, wall assemblies, floor assemblies, and ceiling assemblies.

b) Does NRC currently have a publication detailing nuclear power generating facility building and fire code that is free of site-specific information? Please provide a copy. If not, is the publication of such a document currently being planned? If not, why not?

Fire Safety Testing Agencies

The NRC requires testing of fire safety materials and configurations to be performed by a nationally accredited certification and testing laboratory. On April 16, 1992, Mr. Gerald Brown, a fire protection consultant, alleged to the NRC that Construction Technology Laboratories (CTL), which was not a nationally accredited certification and testing facility, accepted fire barrier test results from penetration seal vendors without independently verifying them, recopied them onto their own letterhead, and then issued the results back to the vendors as independent test verification for customer use.

1) In the absence of independent third-party certification as mandated by model building codes, what procedures does the NRC use to verify the validity of test reports and ensure continued third party follow-up of fire barrier testing?

2) Please provide a copy of the NRC's response (if any) to Mr. Brown's April 16, 1992 allegation entitled "Fire Test Problem", as well as a summary of the findings of any investigations the NRC has performed into those allegations. Has the NRC established that Mr. Brown's allegation of the absence of independent third party testing of any kind was unfounded? If so, please explain, providing all documentation the NRC used to reach its conclusion. If no inquiries were undertaken in response to this allegation, please explain the reason for the NRC's failure to examine the substance of these safety allegations.

3) What criteria does the NRC use to designate a recognized nationally accredited testing facility?

4) What specific regulation determines the specific testing criteria and testing agency protocol?

I appreciate your prompt attention to these safety concerns and request that you direct your staff to contact Michal Freedhoff or Jeff Duncan of my staff at 202-225-2836 to arrange an appropriate timetable for submission of your response to this inquiry.

Sincerely,

Ed Markey

Edward J. Markey
Member of Congress