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**May 23, 2005**

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Office of the Secretary  
United States Nuclear Regulatory Commission  
Washington, DC 20555-0001  
Submitted by email < [secy@nrc.gov](mailto:secy@nrc.gov) > and U.S. Postal Service

Comments of Nuclear Information and Resource Service on Fire Protection Program---  
Post-Fire Operator Manual Actions Draft Regulatory Guide and Proposed Rule (RIN  
3150 AH-54 and DG-1136)

Dear Ms. Viette-Cook:

On behalf of Nuclear Information and Resource Service (NIRS), I am responding to the United States Nuclear Regulatory Commission proposed rulemaking and draft regulatory guide as noticed in the Federal Register, March 07, 2005 (Volume 70, Number 43) Pages 10901-10917.

The Commission proposes to add a new paragraph G.2.c-1 to Chapter 10 Code of Federal Regulation Part 50 Appendix R and a new paragraph P to Appendix R. The changes allow nuclear power plant licensees in the event of a significant fire to substitute “operator manual actions” for physical fire protection features designed and tested to protect the Main Control Room operation of the shutdown and cool down of the reactor.

Under the proposed rule, the Commission would approve licensees actions to send station personnel throughout the reactor building on a vital public safety mission to manually shutdown the reactor a switch, valve, etc. within the reactor) during a fire and allow the sacrifice of the automated Main Control Room operations of reactor safe shutdown equipment to fire damage as the result of the agency inability to enforce current qualification requirements for fire barriers and/or minimum cable separation requirements in conjunction with smoke detectors and automated sprinkler systems as the result of widespread and longstanding nuclear industry non-compliances of the fire code law established under 10 CFR 50.48 and 10 CFR 50 Appendix R III.G.2 (a)(b) and (c).

NIRS is opposed the proposed rule change as written.

NIRS additionally points out with regard to the earlier and related proposed rule making posted in Federal Register notice dated November 26, 2003 (Volume 68 Number 228) “Draft Criteria for Determining Feasibility of Manual Actions To Achieve Post-Fire Safe Shutdown,” [Page 66501-66503], the NRC received more than 400 public comments, the

majority of which were opposed to a rule change that would allow industry to substitute operator manual actions over qualified physical fire protection features. As of this date, these “public” comments are only available on NRC’s internal version of the Agencywide Document Access and Management System (ADAMS). NRC management pulled these public comments from the public version ADAMS and the Rulemaking Forum. As such these comments were not available for public review as pertains to this proposed rulemaking.

NIRS will take this opportunity to request that NRC release these public comments to ADAMS so that the public can access its own identity and comments.

As the proposed rule is written it would allow licensees to substitute operator manual actions for inoperable and non-compliant physical fire protection features. As such, the proposed action constitutes a “Trojan Horse” being brought into NRC fire protection code effectively undermining the defense-in-depth philosophy for nuclear power station fire protection and disarming effective NRC enforcement actions that would seek to bring a stubbornly non-compliant nuclear industry into compliance with effective fire protection regulations to assure public safety.

Therefore, NIRS opposes the proposed rule to add 10 CFR 50 Appendix R III.G. 2.c.1 and Part P to provide operators of nuclear power stations with the option to ignore compliance with fire protection requirements necessary to reasonably assure that redundant electrical cabling as credited in each licensee’s Safe Shutdown Analysis can be reasonably maintained as “free of fire damage” in the event of a significant fire. As such, the proposed rule change is a radical and dangerous departure from current fire protection law that presents undue risk to the public health, safety and security.

NIRS contends:

- 1) The proposed rule does not provide an acceptable equivalent nor does it provide a “comparable” level of protection to safe shutdown equipment as qualified physical fire protection features as duly promulgated by law under CFR 50.48, 10 CFR 50 Appendix A General Design Criteria 3 and Appendix R III.G.2 for pre-01/01/1979 plants and for post 01/01/1979 plants Appendix R provisions as incorporated into the license condition or licensee’s current fire protection program.
- 2)The proposed rule reduces defense-in-depth for U.S. nuclear power stations and creates an undue and unacceptable increase in risk to the public health, safety and security;
- 3) The proposed rule significantly undermines public confidence in NRC’s credibility and future enforcement policy of fire protection requirements for assuring the safe shutdown of the reactor in the event of a significant fire;
- 4) The proposed rule significantly undermines NRC safety oversight and review of fire protection code deviations on safe shutdown systems and effectively eliminates the public’s due process to independently review and challenge potential safety issues arising

from deviations by eliminating the exemption process for fire protection features under 10 CFR 50 Appendix R III.G.2;

5) The proposed rule abandons NRC enforcement actions imposed by Orders issued in 1998 over long standing industry non-compliances with regard to inoperable Thermo-Lag fire barriers;

6) The proposed rule has not adequately considered the significance and impact of operator manual actions over passive fire protection features in response and recovery from security event related fires

### **History**

During the early days of the U.S. nuclear power industry and nuclear power regulation, nuclear power plants had similar to fire protection features to conventional fossil-fuel power generation stations. This level of fire protection was found acceptable if the facility complied with local fire codes and received an acceptable rating from its fire insurance underwriter. Given the level of risk and consequence associated with a fire resulting in a nuclear fuel meltdown and potential catastrophic release of radiation to the atmosphere this was clearly inappropriate and inadequate protection to the public health and safety.

However, the Atomic Energy Commission and its successor, NRC, allowed the nuclear industry the convenience to operate without adequate fire protection up until the Browns Ferry nuclear power station fire on March 22, 1975. The fire and near catastrophic accident was a pivotal event supposedly bringing fundamental changes to fire protection development for the nuclear power industry. The fire started when workers performing a manual action with a lit candle to inspect for air leakage through a non-fire-rated penetration seal in the cable spreading room that led to the reactor building. The candle flame was sucked by a draft into a cable tray and ignited combustible seal material and combustible electric cable jacketing and burned for seven hours. The greatest damage occurred on the reactor building side in an area roughly 40 feet by 20 feet in dimension. More than 1600 electric cables, routed through 117 conduits and 26 cable trays were destroyed including over 600 safety-related power, instrumentation and control cables. Once the combustible insulation burned off the electrical cables, the cables shorted together and grounded to their supporting metal cable trays resulting in the loss of control of safety-related equipment such as pumps, motors and power operated valves. The fire graphically demonstrated that a major loss of control of the safe shutdown of the reactor and the ability to maintain cooling to the reactor can occur within fifteen minutes of initiation.<sup>1</sup>

Browns Ferry station nuclear engineers privately confided a catastrophic release of radiation was avoided only by “sheer luck.”<sup>2</sup>

The Browns Ferry Fire Report as prepared by the NRC described the recovery of the Browns Ferry units following the fire by stating:

*“1.6.3. Provisions to Maintain Important Functions In Spite of Fire*

*During the course of the Browns Ferry fire, numerous systems became unavailable as a result of the cable damage. By a combination of alternative switching, manual manipulations, remote controls, and temporary wiring, the operating staff kept enough equipment operating to shut down and cool down the reactor cores.”<sup>3</sup>*

Despite the role that operator manual actions played in the recovery of the Browns Ferry reactors shutdown and residual cooling, the Browns Ferry Fire Review Group did not recommend increased reliance upon operator manual actions.

Instead they concluded:

*“The Review Group has concluded that existing separation and isolation criteria need improvement. A suitable combination of electrical isolation, physical distance, barriers, resistance to combustion, and sprinkler systems, should be applied to maintain adequately effective independence of redundant safety equipment, and therefore the availability of safety functions, in spite of postulated fires.”<sup>4</sup>*

The cause of the Browns Ferry fire, according to NRC investigation was the direct result of serious fire safety deficiencies at the reactor, including:

- 1) the presence of combustible foam in electrical control systems’
- 2) lax management controls, including inadequate safety reviews that allowed a operator manual action to use an open flame around combustible materials;
- 3) defective installation of electrical cables that crowded them too close together;
- 4) lack of emergency procedures for detecting and extinguishing fire;
- 5) construction and operation of Browns Ferry in flagrant violation of important fire safety requirements

Moreover, despite warnings from senior AEC officials, these violations of fire safety were ignored at Browns Ferry under the approval by federal authorities leading up to the fire. Browns Ferry was granted all the required federal permits, two major safety reviews, approved by periodic onsite inspections and formally certified by federal safety authorities as compliant with fire code.

The Browns Ferry fire demonstrated that significant risks to the public safety and environmental damage arise from:

- 1) Ongoing nuclear operations with safe shutdown systems unprotected from fire, and;
- 2) The Commission’s failure to effectively resolve industry disputes over safety-related fire protection violations through effective oversight and enforcement.

Commission Chair Shirley Jackson summed up the Browns Ferry fire investigation as such;

*“The investigations that followed this event found significant inadequacies both in the fire protection design features and in licensee procedures. The investigation concluded the occupant safety and property protection concerns of the fire insurance underwriters did not sufficiently encompass nuclear safety issues, especially in terms of the potential for fire damage to cause the failure of redundant trains of systems and components important for safe reactor shutdown. The NRC Browns Ferry special review team recommended that the NRC (1) should develop detailed guidance for implementing the general design criterion for fire protection; and (2) should conduct a detailed review of the fire protection program at each operating nuclear power, comparing it to guidance.”<sup>5</sup>*

In May 1976, NRC issued two sets of technical guidelines on fire protection, which incorporated the recommendations of the Browns Ferry special review team. Operator manual actions were not incorporated into these guidelines, despite the fact that just over a year earlier it was operator manual actions taken during the fire as repairs to fire damaged systems that averted reactor core damage.

The Commission, itself, determined that given the generic nature of the fire risk and disputed industry violations, a rulemaking was initiated to ensure the public safety-related implementation of NRC fire protection standards that in part required physical fire protection features.

In November, 1980 the NRC published its “Fire Protection” rule, specifying detailed regulatory requirements of 10 CFR 50 Appendix R that were focused on resolving previously disputed fire protection issues. Where redundant electrical cabling appeared in the same fire zone, physical fire protection features were prescribed for maintaining the one of safe shutdown system to be maintained free from fire damage by 1) a qualified three-hour rated fire barrier, 2) a minimum separation of twenty-feet with no intervening combustibles between redundant circuits in conjunction with detection and automated suppression equipment, or 3) a qualified one-hour barrier in conjunction with detection and automated suppression.<sup>6</sup>

The qualification of the three-hour and one-hour fire barrier was to be independently tested to a standardized furnace tests for time/temperature durability established by the American Society for Testing and Measures (ASTM E-119).

During this earlier rulemaking, the Commission determined that the risks and consequences from fire damage to safe shutdown equipment were so great that they required the prescriptive actions to all reactors.

The new fire protection requirements also allowed licensees to apply for an exemption to Appendix R, in cases where fire analysis could demonstrate that alternative fire protection features would provide an equivalent level of fire safety. This exemption process provided for the NRC and public to review and potentially challenge the industry safety analysis. Exemptions were not automatic and in some cases NRC denied the

requests. However, the exemption provision resulted in more than formal 850 exemptions to the fire code.

There is a key portion of U.S. nuclear power fire protection history that NRC and industry have privately agreed to ignore in the current deliberations and disputes over operator manual actions. It regards the fact that inoperable Thermo-Lag 330-1 fire barriers were discovered to be widely deployed through the U.S. nuclear power industry for the purpose of meeting the requirements of 10 CFR 50 Appendix R III.G.2. However, the fire barriers were subsequently exposed by a safety conscious fire protection contractor, who working with NIRS revealed that the bogus fire barriers were prone to rapid failure under standardized fire tests. NRC declared the fire barriers inoperable in 1992. NRC and a majority of nuclear industry operators engaged the next 6 years in meetings to review the technical and safety analysis for bringing nuclear power plant operators back into compliance with the physical fire protection features to maintain equipment fire for damage as required. Eventually, the nuclear industry was subject to 17 NRC Confirmatory Action Orders issued for 24 nuclear power station units that had not resolved fire protection violations for safe shutdown requirements by 1998. The Orders were confirmed and consented to by industry. These Orders did not include operator manual actions.

Between 2000 and 2004, renewed NRC fire inspections focused chiefly on whether or not industry had brought its Thermo-Lag fire barrier violations into compliance with NRC fire code discovered that a significant number of these operators never fulfilled their obligations as Ordered for restoring fire barrier operability or achieve cable separation. Instead, industry quietly and illegally opted to sacrifice these electrical systems in the event of fire. Instead, in the event that the safe shutdown electrical wiring burned away due to nonfunctional fire barriers and inadequate separation, operators would simply send an operator or another company employee throughout the nuclear station to manually operate once control room operated safe shutdown equipment and/or disable possibly numerous inadvertent and spurious operations of safety-related equipment resulting from electrical shorts (“hot-shorts”) by manually throwing a switch, pulling a circuit breaker, or turning a valve to shutdown the reactor. In many cases, these operator manual actions involved numerous and complex actions. While a few NRC inspectors had randomly, on a case-by-case basis, provided approval for a small number of simple operator manual actions through the regulatory exemption process, the industry had adopted a wholesale application of manual actions that never sought NRC review or approval nor in many cases completed their own adequate safety reviews. In case after case, NRC inspectors found that licensees were unable to validate that the manual actions could be accomplished to shut the reactor down if there was a serious fire that destroyed the unprotected electrical cables. Employees were designated to enter station areas that would potentially be fully involved in a fire to manually operate reactor safe shutdown equipment. The Shearon Harris nuclear power stations was discovered to have illegally substituted more than 100 unapproved manual actions for physical fire protections including fire barriers and cable separation.

NRC identified that licensees had taken manual actions to the “extreme interpretation” resulting in a significant increase in risk of reactor core damage in the event of fire. As one NRC official explained “*This condition is similar to the condition Browns Ferry was in prior to the 1975 fire.*”<sup>7</sup> NRC discovered that the violations were so numerous throughout the industry that an enforcement effort “*creates a prospect of significant resource expenditure without clear safety benefits. Licensees faced with enforcement actions might flood NRC with exemption or deviation requests, which would divert NRC resources from more significant safety issues and may not result in any net safety improvement if the operator manual actions are determined to be acceptable.*”<sup>8</sup>

In fact, the nuclear industry explicitly threatened to agency.

This is supported by NRC staff statements:

*“They’ve been holding their threat of ‘1000 exemptions’ over our heads like the Sword of Damocles rather than emphasize that these actions can be done safely (what public reacts to- public cares not about exemption burden.”*<sup>9</sup>

Faced with an explicit industry threat of a massive submittal of industry exemptions requests in administrative “civil disobedience,” NRC under took the current proposed rule making to codify manual actions as the equivalent to the qualified fire barriers, cable separation requirements and detection and automated suppression equipment. Industry through this willful and methodical strategy of law breaking is now seeking to influence NRC to undertake new law making that will financially benefit the nuclear industry without benefiting public safety as a result of reducing defense in depth at nuclear power stations and increasing the risk of fire damage to safe shutdown equipment with unacceptable consequences to public health and safety.

Faced with this widespread and stubborn industry non-compliance, NRC now proposes to effectively abandon regulatory enforcement of this section of the fire code nullifying industry long held commitments to restore fire barrier operability and cable separation requirements. Instead, NRC proposes to provide licensees with an option to voluntarily abandon physical fire protection requirements through an alternate criteria that would codify “feasible” manual actions as compliant and equate these actions with qualified physical fire protection features that industry has otherwise been unwilling to upgrade to.

NIRS contends that these unapproved and illegal operator actions were willfully undertaken by industry in defiance of current fire protection law, Confirmatory Action Orders and the license amendment process through the established exemption and deviations process.

The proposed NRC rulemaking and industry actions reverse the decisions made in wake of the Browns Ferry fire for improvement of physical fire protection features. The proposed rulemaking effectively returns fire protection at U.S. nuclear power station to the unduly and unacceptably dangerous days of pre-Browns Ferry fire conditions.

## Why NIRS opposes the adoption of the proposed rulemaking

1) The proposed rule does not provide an acceptable equivalent or rises to a “comparable” level with qualified physical fire protection features as promulgated by law under 10 CFR 50.48, 10 CFR 50 Appendix A Criterion 3 & Appendix R III.G.2.

The propose rule states that *“The proposed operator manual actions offers protection comparable to the latter two options (III.G.2b-qualified 1-hr barriers with detection and automated suppression and III.G.2c-minimum separation distances between redundant circuits with no intervening combustibles in conjunction with detection and automated suppression) both of which require the additional layer of defense in depth protection provided by having fire detection and automatic suppression.”*<sup>10</sup>

NRC arbitrarily makes this statement without providing any analysis as to how a extremely broad set of manual actions can be qualified as comparable to tested and inspected physical fire protection features that are designed and constructed to provide repeatable results under national standardized fire tests.

In its rulemaking process, NRC wrongfully equates its surrendering of the expressed intent and requirement of Appendix R III.G.2a, b and c that safe shutdown systems **“to be maintained free from fire damage”** by the broad substitution of largely uninspectable manual actions that assumes redundant safe shutdown circuits have been destroyed by fire. This reduction in safety margins and increase in risk through by surrendering control room operation can not logically be a “comparable protection” when compared to the current intent and requirement of III.G.2.a, b & c.

This concern is supported by statements made by NRC staff:

*“Firstly, when you perform a Fire-Safe-Shutdown (FSSD) analysis (Appendix R), you start at the top & work down i.e., you try to meet III.G.1 have the redundant trains in separated fire areas. When/if that does not work, you progress to III.G.2, protect the train, of concern that is in the opposite trains fire area with the accepted methods described in the Reg (3-hr barrier, or 1-hr w/ auto suppression & detections, or 20’ combustible free separation w/auto suppression & detection. If you cannot meet .1 or .2 you must default to .3 alternative/dedicated shutdown. Which brings in III.L This design decision was not meant to be made casually!!! .3 was put in the Regs for areas where you COULD NOT meet .1 or .2*

*.3 assumes that the NPP (nuclear power plant) will be abandoning the Main Control Room (MCR)~this is where the large jump in risk comes in~ every NPP is much safer shutting down& controlling the reactor from the MCR (main control room) rather than w/ Alternative/dedicated shutdown which provides Minimum equipment & instrumentation, (often local) control .”*<sup>11</sup>



NRC staff has acknowledged that abandoning physical fire protection features for operator manual actions does not provide an equivalent or “comparable” level of protection and can represent a “*large jump in risk.*”

It is important to understand the origins of the current fire protection requirements that were duly promulgated into law in the aftermath of the 1975 Browns Ferry fire. In the Statement of Considerations for Appendix R, the basis for III.G.2 provides as follows:

*“Statement of Considerations for 10 CFR 50.48 and 10 CFR 50 Appendix R G. Protection of Safe Shutdown Capability Technical Basis. The objective for the protection of safe shutdown capability is to ensure that at least one means of achieving and maintaining safe shutdown conditions will remain available during and after any postulated fire in the plant. **Because it is not possible to predict the specific conditions under which fires may occur and propagate, the design basis protective features are specified rather than the design basis fire.** (Emphasis added) Three different means for protecting the safe shutdown capability outside of containment are acceptable. The first means is separation of redundant safe shutdown trains and associated circuits by means of a 3-hour fire rated barrier. The second means is a combination of separation of redundant safety shutdown trains and associated circuits by a 1-hour fire rated barrier and automatic fire suppression and detection capability for both redundant trains. The third means, which may be used only when redundant trains and associated circuits are separated by 20 feet or more of clear space, requires automatic fire suppression and detection systems in the area. An alternative or dedicated safe shutdown capability independent of the fire area is required if fire protection for safe shutdown capability can not be provided as outlined above...”<sup>12</sup>*

NRC and industry have no equivalent qualification process for operator manual actions

There is no process for qualifying operator manual actions that bears any resemblance of equivalence to current qualification requirements for the fire barriers that NRC and these non-compliant operators action seek to replace. The required qualification of the three-hour and one-hour fire barrier is independently tested to a standardized furnace tests for time/temperature durability established by the American Society for Testing and Measures (ASTM E-119).

NRC and industry have admitted that qualifying operator manual actions can not replicate all of the conditions encountered in an actual fire to include; smoke, fire, radiation, human response to adverse situations, etc.

NRC inspectors have stated:

*“Recent inspections have found that some licensees have taken manual actions to the extreme interpretation such that no wrap is provided with operators solely relying on responding to the mal-operations after they occur in III.G.2 fire areas. This condition is similar to the condition Brown’s Ferry was in prior to the 1975 fire.”<sup>13</sup>*

*“From the risk perspective, a consultant has recently provided risk information to the office of Research which shows that multiple manual actions could, (based on risk insights) result in an unacceptable low probability of safe shutdown. Multiple manual actions, in a fire area, can result in being a significant contributor to fire induced CDF (Core Damage Frequency)... NFPA 805 (National Fire Protection Association) also noted that where manual operator actions are relied on to provide the primary means of recovery in lieu of providing fire protection features, risk may be increased.”<sup>14</sup>*

*“Appendix R does NOT offer manual actions as an acceptable alternative to comply with the separation requirements of Section III.G.2 of Appendix R. ... During the Thermo-Lag 330-1 resolution activities of the 1990’s many utilities, incorporated manual actions WITHOUT prior staff review and approval. This was done using the licensee interpretation of the standard licensing condition and concluding that the manual actions did NOT adversely affect the ability to achieve safe shutdown.”<sup>15</sup>*

NIRS note that the National Fire Protection Association has not endorsed operator manual actions as comparable to prescriptive qualified physical fire protection features.

NIRS contends that maintaining control room operated safe shutdown systems to be free from fire damage per current fire code regulations is the safest practice in the event of fire.

NRC staff statements have supported these concern;

*“When replacing a barrier by human action, it seems to me that what you are doing is giving up a reliance on detection and suppression, which is enabled by the existence of the barrier, and replacing it with a reliance on the operators to recover, or otherwise find a workaround for those things that the barrier would have protected. In a sense, what you are saying is that, in the time line of the fire progression, you’ll initially give up the equipment whose functionality was supposed to be protected, and rely on a late recovery.”<sup>16</sup>*

NIRS further points to NRC raising similar concerns for operator actions in Information Notice 97-78: Crediting of Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times” dated October 23, 1997. IN 97-78 states:

*“... the number of licensees that have implemented changes to their facilities or operations that may inappropriately credit operator actions in place of automated system. Licensees have also altered operator actions, including response times, previously described in their licensing basis. Often these changes are implemented without adequate consideration of human performance issues that might affect the acceptability of such changes.”<sup>17</sup>* The Information Notice further states *“In those instances where licensees consider temporary or permanent changes to the facility which credit operator actions, the NRC has relied on the guidance provided in Generic Letter (GL) 91-18, Revision 1, “Resolution of Degraded and Nonconforming Conditions and on Operability, and ANSI/ANS 58.8, “Time Response Design Criteria for Safety Related*

*Operator Actions,” 1984, (ANSI-58.8) for evaluating such changes. GL 98-18 Rev. 1 discusses the appropriateness of temporary use of operator action in place of automatic action and states, in part, that:*

*...it is not appropriate to take credit for manual action in place of automatic action for protection of safety limits to consider equipment operable. This does not preclude operator action to put the plant in a safe condition, but operator action cannot be a substitute for automatic safety limit protection. ...Although it is possible, it is not expected that many determinations of operability will be successful for manual action in place of automatic action... (Such changes) are expected to be a temporary condition until automatic action can be promptly corrected in accordance with 10 CFR 50 Appendix B, Criterion XVI, ‘Corrective Action’”.*<sup>18</sup> As such, NIRS contends that the proposed “feasible” or possible operator manual actions represent an inappropriate substitution for the automatic features of fire barrier protection and cable separation in conjunction with suppression and detection to preserve free from fire damage the automatic actions for control room operation of the safe shutdown of the reactor in the event of fire.

NIRS further disagrees with NRC and licensee assertions that all operator manual actions have been reviewed for safety, and the operator manual actions have been accepted against a set of criteria to determine their acceptability. NIRS contention is supported by NRC staff statements including;

*“This is not a true statement. First, we have not inspected all the plants yet against the criteria contained in the existing inspection module. Second, we typically only inspect 3-5 fire areas during a TFP (Triennial Fire Protection inspection). Thus even for plants we have inspected manual actions at, we may not have looked at all the manual actions.”*<sup>19</sup>

Furthermore, the current proposed rulemaking does not commit NRC staff to review all previously unapproved and illegal operator manual actions as currently employed by licensees in lieu of compliance with fire code requirements. NRC does not know the extent including the number of actions and safety significance of each unapproved and illegal operator manual action and whether or not these actions can be reliably executed in the event of a fire. This lack of regulatory oversight and enforcement leaves reactor safe shutdown systems in a vulnerable unanalyzed condition. This does not represent a “comparable” status of fire protection readiness.

NIRS contends that NRC staff sought to find comparable fire protection regulations for operator manual actions and failed to produce such comparable actions. This is exemplified by NRC efforts to find comparable actions between Germany and those being proposed for the United States governing acceptance criteria for introducing operator manual actions as a alternative means of fire protection. The staff identified that, in fact, the German fire code for nuclear power stations precludes substituting operator manual actions for fire code requirements. The staff further identified that the proposed rule change was unique in its treatment and relaxation of fire code requirements for safe shutdown systems, a process that the agency admittedly could very well lose control of oversight and enforcement.

This is supported by statements made in NRC staff email communications:

03/22/2004 1:33 PM >>James Downing: *“Attached is the paper, it compares the German KTA 2101 series to the NRC fire protection regulation.”*

03/22/2004 >> 3:21 PM >>Ray Gallucci: *“Few equivalencies are given in the German code to permit deviation from the mandated structural separation requirements and no references to any manual actions are cited as alternative means of fire protection.”*

>> 4:26 PM >> David Diec: *“The German code mentioned Section 6.7 of KTA 1201 code discusses substitute measures in situation where measured and equipment-related protections are not available, as well as the behavior of personnel in case of fire. Do we have access to this document (KTA-1201)?*

>> 4:31 PM >> James Downs: *“I believe that reference in made to fire brigade operations... but here’s KTA 1201 to be sure.”*

>> 4:51 PM >> David Diec: *“Take a look at Section 6.7.3 Fire Prevention (pg. 10). One could argue that ‘measure required in case of a non-availability of structural fire protection measures’ to include manual actions. However, I cannot find measure required for systems and components fire protection measures.”*

>> 5:04 PM >> Ray Gallucci: *“I think the wording and intent of Sections 6.7 inhibit, if not preclude, extrapolating to include OpManAx (operator manual actions). I believe, as James, that any manual actions refer only to fire brigade /manual suppression activities.”*

03/23/2004 >> 7:19 AM >> David Diec: *“glad to hear. I wouldn’t want to think that we are the first to face a running away train. Apparently, we are.”<sup>20</sup>*

Is a nuclear power station safe shutdown system reliant upon 99% operator manual actions for its fire protection acceptable?

In addition to bogus Thermo-Lag fire barriers installed in nuclear power stations for decades, NIRS is aware of numerous fire barrier materials that do not meet current NRC fire code requirements. Most recently, April 2005 fire test results indicate that Hemyc/MT 1-hour and 3-hour rated fire barrier systems failed ASTM E-119 tests in 15 minutes and 54 minutes, respectively.<sup>21</sup>

NRC has not established any quantifiable and quantitative limits on what percent operator manual actions constitutes an unacceptable and undue risk to public safety. The Shearon Harris nuclear power station already relies upon more than 100 operator manual actions for non-compliant physical fire protection features.

NIRS contends that the referenced *“running away train”* involves the complete loss of the NRC staff’s ability to effectively oversee and take enforcement action regarding safety significant aspects of industry fire safety analysis in an exodus from established fire code governing qualified fire barriers and minimum separation requirements (10 CFR 50 Appendix R III.G.2 a, b & c) to nebular paper operator manual actions largely reviewed only by industry itself. Given a large number of operator manual actions and the significant number of actions that NRC has already determined were not executable,

NIRS contends that an explosion in number of manual actions and their safety consequence can not be determined as comparable to the physical protection provided by qualified fire barrier systems and cable separation requirements.

Human actions vs. qualified fire barrier and separation performance are not comparable

Issues associated with human reliability raise a whole host of uncertainty factors that contradict NRC and industry assertions that manual actions are comparable to qualified, inspect able physical fire protection features. There are a number of uncertainties associated with such a comparison including human error, fear, potentially inaccessible areas due to smoke, heat, radiation, locked doors, and other adverse circumstances that can not be adequately simulated.

Human actions are identified as a significant challenge area. Staff has identified that it is “perhaps the most challenging of the identified needs.”<sup>22</sup> Staff notes that “human actions can also be a critical aspect of the fire response procedures under a range of circumstances.”<sup>23</sup>

According to NRC memorandum to the NRC Advisory Committee on Reactor Safeguards (ACRS) on human performance impact on nuclear power plant safety:

*“The analyses performed to date underscore the significant contributions that human performance has made to operating events. Specific failures in operating events were analyzed with SPAR models. This includes failed or erroneous human actions that caused event initiation, equipment unavailability, or demand failures. ...Human performance produced significant increases in plant risk. ...These risk increases were due in large part to errors and failures committed by personnel and organizations that operate and maintain these plants”.*<sup>24</sup>

The memo points out that errors can be introduced by a variety of human and organizational contributors and significantly influence the outcome of an event such as a fire. These contributors were identified to include corrective actions, unworkable and deficient procedures, shortfalls in training. Utility inattention to recurrent problems was clearly evident in a large number of these events, including inattention to NRC inspection findings, and operating with known design deficiencies. Combined with other events (i.e. fire) and failures (i.e. loss of cable functionality for safe shutdown systems due to fire damage) they produced challenges to plant systems and resources that increased risk. In 20 operating events analyzed using qualitative and quantitative SPAR methods, the average contribution of human performance to the event importance was over 90%.<sup>25</sup> “In nearly all cases, plant risk more than doubled as a result of the operating event---and in some cases increased by several orders of magnitude over the baseline risk presented in the PRA. This increase was due, in large part, to human performance.”<sup>26</sup>

NIRS contends that the current generations of Probabilities Risk Assessments (PRA) for quantifying and qualifying contributing human reliability factors are not comparable to

standardized fire tests such as ASTM E-119 time/temperature curve furnace tests used to qualify fire barriers.

To compensation for the inability to make human performance and physical fire protection features comparable, NRC proposes to reduce the associated uncertainty with human performance by incorporating substantial time margins due to these potential time impacts in calculating the differences between assumed times and actual times to successfully complete of a set of manual actions that are time critical in preventing a core melt accident.

Given that fire can quickly render a large number of safe shutdown systems inoperable as demonstrated in the Browns Ferry fire (600 safety-related circuits within 15 minutes of initiation, as well as a large number of associated circuits that can cause spurious operations of equipment complicating or preventing safe shutdown and recovery operations) these time margins do not provide a level of confidence as comparable to a qualified three hour rated fire barrier or a one hour rated fire barrier used in conjunction with suppression and detection equipment.

Qualified passive fire protection features have the distinct and incomparable advantage over the proposed operator manual actions in that qualified fire barriers and physical separation are effective in providing protection to safe shutdown equipment without relying on human performance to: 1) detect and locate the fire; 2) identify safety systems or spurious operations impacted by fire and; 3) dispatch operator manual actions to start or stop safety-related equipment. As a general rule NRC and the licensees appear to begin counting from “zero” for constructing timelines for the initiation of response times for operator manual actions with the detection and location of the fire and/or the initiation of the undesirable event (equipment failure or spurious operation). The far more critical time starts with the actual initiation of the fire and the time of concern deals with how fast operators can then detect an undesired event such as the failure of safe shutdown equipment or the spurious operation. Fire barriers and cable separations are passive features whereas operator manual actions are reactive features. A qualified passive fire protection feature does not have to be concerned with the potential for delayed detection and response as does an operator manual action even if worst case scenarios for timing are incorporated into all manual actions.

2) The proposed rule significantly reduces defense-in-depth for U.S. nuclear power stations and creates an undue and unacceptable increase in risk to the public health, safety and security

NRC has repeatedly claimed that the agency framework for fire protection is based on a philosophy of “defense-in-depth”: providing a balance among preventing fire from starting; rapidly detecting, suppressing, extinguishing, and limiting the spread of those fires that occur; designing safety systems so that, even if a fire starts and burns for a considerable time, it will not interfere with the performance of essential reactor safety equipment.

As former Commission Chair Shirley Jackson has summed up:

*“The defense-in-depth philosophy ensures that safety will not be wholly dependent on any single element of design, construction, maintenance, or operation of a nuclear facility.”*<sup>27</sup>

NIRS contends that NRC and industry rulemaking efforts undermine the defense-in-depth fire protection features designated under *“designing safety systems so that, even if a fire starts and burns for a considerable time, it will not interfere with the performance of essential reactor safety equipment.”* NRC and industry are not proposing to add qualified operator manual actions in addition to these physical fire protection features. They are proposing to substitute manual actions for long standing non-compliant fire protection features including bogus fire barriers and failure to maintain minimum separation between redundant safe shutdown systems.

Specifically for Appendix R III.G.2 areas of nuclear power stations, the substitution of operator manual actions for qualified and operable fire barriers, minimum cable separation and detection and automated suppression systems while abandoning noncompliant physical fire protection features is a significant reduction in defense-in-depth.

NRC and industry safety and risk analysis have become increasingly reliant upon modeling the initiation, progress and consequence of fire and has repeatedly come under question by fire experts including the NRC’s own Advisory Committee on Reactor Safeguards. NRC readily admits *“it is difficult to accurately the behavior of fire and its consequences.”*<sup>28</sup> This inability to accurately predict fire behavior and its consequences is documented by an actual fire at the San Onofre nuclear generating station on February 3, 2001. The fire generated a much higher heat release rate than would normally be assumed in typical fire risk modeling to perform a probabilistic risk assessment. As NRC stated *“This event demonstrates that energetic electrical faults instantaneously release large amounts of electrical energy and may bypass the normal fire initiation and growth stages.”*<sup>29</sup>

As such, the importance of maximizing defense-in-depth for essential systems such as the safe shutdown of the reactor in the event of fire cannot be over emphasized.

The unspecified but potentially large number of unreviewed operator manual actions that will be incorporated into fire protection programs by adoption of the rule is a serious erosion in the confidence of the defense-in-depth philosophy. The proposed rule addresses only future or “forward going” qualified operator manual actions in lieu of physical fire protection features Appendix R III.G.2 c 1. It does not effectively address an unknown and perhaps unquantifiable number of manual actions that licensees are currently taking credit for but that are not captured by the NRC inspection process. An unidentified number of these operator actions are likely unreviewed and unperformable and would be incorporated into the licensing basis. These actions are wrongly credited in licensees’ safety analyses. As such this constitutes in reality a reduction in defense in depth and an undue increase in risk to public health and safety. It is not unlike seeing

only the tip of the iceberg for the larger volume of fire protection non-compliances that remain unseen until brought out by a trial by fire.

The concern for this erosion in defense-in-depth is supported by NRC staff statements;

*“As an ex-operator I can tell you that I have every reason to believe that there may be operator manual actions out there that can not be done in the time assumed and/or can not be accomplished by every operator... If we say anything about the health and safety of the public, we should make it less absolute, such as- as indicated by limited sampling, there appears to have been no compromise to the health and safety of the public.”<sup>30</sup>*

Additional staff comments reflect this concern;

*“Thanks for that---listen---have you heard about the manual action criteria being recommended for forward fit only? Apparently they (Sunil or RES) seem to think that inadequate manual actions will be identified within the ROP process. Which---in my opinion would be too late because without criteria to be measured against the only other way we will find there was a problem is for the manual action to fail when needed (i.e. a real situation) and then we could very well be looking at a damaged core or worse.”<sup>31</sup>*

NRC’s inspection bases for manual actions recognize that fire is a significant contributor to overall reactor risks. While widely varying, fire events have been found to contribute as much as 80% of the overall frequency of reactor core damage as the result of an internal event.<sup>32</sup> The NRC inspection program further identifies that a nuclear power station’s fire protection program is required to extend the concept of defense-in-depth to fire protection areas of the nuclear station that are important to safety including providing protection for structures, systems and components important to safety so that a fire not promptly extinguished by fire suppression activities will not prevent the safe shutdown of the reactor. *“If defense in depth at nuclear power stations is not maintained by adequately implemented fire protection program, overall plant risk can increase.”<sup>33</sup>*

NIRS contends that operator manual actions introduced first as “compensatory” actions are now being proposed to be codified as acceptable options to qualified physical fire protection features promulgated under Appendix R III.G.2. This constitutes a significant reduction in defense-in-depth when the fire barrier or cable separation requirement is not being restored to a compliant condition but being substituted by a non-equivalent operator manual action.

NIRS further disagrees with NRC assertions that the public health and safety or the environment has never been compromised due to unapproved operator manual actions. This is confirmed by NRC staff communications that state:

*“I don’t know what compromised safety means in this case. However, I suspect that some manual actions represent an increase in risk over a properly functioning DID (Defense-In-Depth) element and thus affect safety. Thus, I am not sure that this statement is entirely accurate in all cases. This would be an even more difficult statement to support*



*in the case of unapproved manual actions that the inspection staff has found won't work. Further, I am not sure that we have inspected all unapproved manual actions.*"<sup>34</sup>

NIRS contends that incorporation of operator manual actions into 10 CFR 50 Appendix R III.G.2 effectively nullifies confidence that defense-in-depth for nuclear power station fire protection is being adequately maintained. As such, such actions constitute an undue risk to public health and safety.

3) The proposed rule significantly undermines public confidence in NRC's credibility and future enforcement policy of fire protection requirements for assuring the safe shutdown of the reactor in the event of a significant fire;

NIRS disagrees with NRC and industry assertions that the safety benefit of forcing licensees to comply with the regulation is not significant when compared to the costs in staff time and resources required for enforcement.

NRC staff has stated that these assertions are "*particularly troubling. It seems to be predicated on the idea that all manual actions we review are acceptable or prudent. In fact this is not the case.*"<sup>35</sup>

NIRS disagrees with NRC assertions that it is not changing the fire protection rule to accommodate the financial interest of the nuclear industry by accommodating widespread and long standing licensee violations of fire protection requirements. This is confirmed by NRC staff statements:

*"The NRC is not changing the rule to accommodate licensees. I am not sure that I agree with this statement. (And I am not sure all the inspectors on my staff would agree either.) The timing of the original response back to NEI discussing our position on manual actions followed by the subsequent change in NRC direction on this issue probably also does not support this position."*<sup>36</sup>

Similarly, staff has stated:

*"(2) It appears that the thrust of the basis is that materials such as Thermo-lag, a material found to have a fire rating different from what was thought originally, is being replaced by manual actions. Yet, the discussion talks generally about replacing barriers with manual actions. Is the intent of the rule to allow fire barriers which are simply not maintained properly to be substituted by manual actions?"*<sup>37</sup>

4) The proposed rule significantly undermines NRC safety oversight and review of fire protection code deviations on safe shutdown systems and effectively eliminates the public's due process to independently review and challenge potential safety issues arising from deviations by eliminating the exemption process for fire protection features under 10 CFR 50 Appendix R III.G.2;

Currently, if a licensee wants to deviate from fire protection of safe shutdown they have to submit an exemption with safety analysis. Under the current rulemaking, NRC staff

will not see the bulk of these deviations as the exemption application process will be abandoned. While this may save the midnight oil at NRC, it leaves public safety unacceptably in the dark. Given the significant number of unapproved and largely unanalyzed operator manual actions to date, the significance of the loss of this safety oversight and potential safety impact has been trivialized by NRC in the proposed rule. The concern for this trivialization is supported by statements made by staff referencing the risk associated with abandoning the physical protection of safe shutdown systems to be maintained free from fire damage:

*“Firstly, when you perform a Fire-Safe-Shutdown (FSSD) analysis (Appendix R), you start at the top & work down i.e., you try to meet III.G.1 have the redundant trains in separated fire areas. When/if that does not work, you progress to III.G.2, protect the train, of concern that is in the opposite trains fire area with the accepted methods described in the Reg (3-hr barrier, or 1-hr w/ auto suppression & detections, or 20’ combustibile free separation w/auto suppression & detection. If you cannot meet .1 or .2 you must default to .3 alternative/dedicated shutdown. Which brings in III.L This design decision was not meant to be made casually!!! .3 was put in the Regs for areas where you COULD NOT meet .1 or .2*

*.3 assumes that the NPP (nuclear power plant) will be abandoning the Main Control Room (MCR)~this is where the large jump in risk comes in~ every NPP is much safer shutting down& controlling the reactor from the MCR (main control room) rather than w/ Alternative/dedicated shutdown which provides Minimum equipment & instrumentation, (often local) control.”<sup>38</sup>*

Under the proposed rulemaking, the public will also be denied its due process to review the operator manual actions that are being substituted for qualified physical fire protection features per 10 CFR 50 Appendix R III.G.2. Under the current exemption request process the Commission seeks public comments on a proposed determination for exemption and deviations. Any comments received within 30 days after the date of publication of public notice to the Federal Register that regard the exemption can be considered in making any final determination on the safety significance of the exemption request. Currently any person who perceives that their safety interest may be affected by such exemptions and deviation and who wishes to participate as a party in the proceeding can file a written request for a hearing and a petition for leave to intervene. The proposed rule effectively eliminates this due process and opportunity to independently review. As such, the proposed rule effectively removes this check and balance potentially affecting public health and safety. Given the degree of industry violations that have spawned this proposed rulemaking the public safety can be significantly impacted. This contention is supported by statements made by staff with regard to operator manual actions that were subsequently inspected that had been credited without submission to NRC as an exemption request:

*“We have found, during recent inspections, that licensees are crediting operator manual actions for fire damaged circuits. The current rule does not allow this. We agree with industry that some may be feasible. Most we have reviewed have not had very good licensee analysis.”<sup>39</sup>*

Given the poor industry record for performing safety analysis on operator manual actions it makes little sense for NRC to proceed with this rulemaking. NIRS contends that if NRC reduces its oversight of deviations from qualified physical fire protection features to basically a spot check and simultaneously eliminates entirely the ability of the public to review and challenge these potentially safety related deviations, then the overall risk to public safety from a fire at a nuclear power station will unacceptably increase.

5) The proposed rule abandons NRC enforcement actions regarding Orders issued in 1998 over long standing industry non-compliances with regard to inoperable Thermo-Lag fire barriers and non-compliance with 10 CFR 50 Appendix R III.G.2.

In 1998, NRC issued 17 Confirmatory Action Orders Modifying License in accordance with the Atomic Energy Act sections 103, 161b, 161i, 161o 182, and 186 and NRC regulations in 10 CFR 2.202 and 10 CFR 50 impacting 24 nuclear power plant units that had not implemented inoperable Thermo-Lag 330-1 corrective action programs. These Orders were issued as the result of dozens of technical and safety analysis meetings between NRC staff and non-compliant licensees in the development of a schedule to implement corrective actions to restore compliance to 10 CFR 50 Appendix R III.G.2 requirements. The corrective actions outlined in the Confirmatory Orders were agreed to by each of the licensees who confirmed that the corrective actions would be completed by specified time table concluded at the latest in 2000.

Each Order expressly stated that each agreed upon licensee commitment was acceptable to NRC and “necessary for NRC to conclude that public health and safety are reasonably assured.”<sup>40</sup> The Orders were explicit to preclude that any further corrective action schedule slippage and to assure public health and safety. NRC staff confirmed the licensees’ commitment to the Order by letter. The licensees agreed to the actions by letter making the Order immediately effective upon issuance. None of the licensees requested any further hearings to consider whether or not these Orders should be sustained.

To the best of our knowledge the Orders and licensee commitments did not include operator manual actions as corrective actions.

When NRC began conducting its Function Fire Protection Inspection Program of nuclear power station licensees to confirm Thermo-Lag corrective actions and compliance strategies in 2000 (which evolved into the current Triennial Fire Protection Inspection Program), NRC inspectors discovered that licensees under Thermo-Lag Orders had not complied with commitments for corrective actions. For example, instead of removing and replacing inoperable Thermo-Lag 330-1 fire barriers, the bogus barriers were removed from III.G.2 compliance areas in the nuclear power station and never replaced with operable barriers. Other inoperable Thermo-Lag fire barriers were simply left in place over safe shutdown electric circuits. The still non-compliant licensees instead credited unapproved, largely unanalyzed and illegally adopted operator manual actions. Many of these illegal actions persist in leaving safe shutdown electrical circuits

unprotected from fire damage in the event of a significant fire. As such the failure to enforce compliance through duly issued Orders places the public safety at undue risk.

NRC failed to follow through with enforcement of these Orders as “necessary for NRC to conclude that public health and safety are reasonably assured” per its authority and duty to uphold the public health and safety under the Atomic Energy Act Section 186.

NRC did not conduct an investigation into whether or not the failure of the licensees to comply with the 1998 Thermo-Lag Orders was willful.

The Thermo-Lag Confirmatory Orders are not even mentioned in SECY 03-100 which establishes that the unapproved, unreviewed and therefore illegal operator manual actions stem in large part from the failure of NRC enforcement policy for longstanding Thermo-Lag 330-1 violations.

The lack of effective enforcement policy significantly undermines NRC credibility with both the public it is mandated to serve as protector and the nuclear industry it is designated to regulate for safety. The NRC’s failure to follow through on the enforcement of Orders demonstrates that the agency will have no credible authority to effectively oversee and enforce the more nebulous and convoluted policy it is proposing to create by allowing the substitution of operator manual actions for prescriptive qualified fire protection features.

6) The proposed rule has not adequately considered both the significance and impact of operator manual actions over passive fire protection features in response and recovery from security event related fires

NIRS contends that NRC and industry have not adequately evaluated the significance and impact of codifying operator manual actions as an option for compliance to the maintenance of qualified passive fire protection features. Under the clear and present danger of a Post September 11<sup>th</sup> world and the lessons that need to be learned about the catastrophic fires of the World Trade Center, fire protection and security infrastructure can not be considered and treated as separate issues. Decisions about fire protection must be made simultaneous to security preparations and response.

It is absolutely irresponsible and reckless of the NRC to be relaxing fire protection features at nuclear power stations with the 9/11 demonstration of the potential catastrophic consequence as the result of terrorism or sabotage. If anything, the 911 experience has demonstrated that there is an urgent need to strategically fortify and bunker safe shutdown capability rather than relax physical fire protection features for these potentially enhanced radiological targets. Bunkered safe shutdown systems are likely more effective than guard towers, but certainly the reduction in qualified fire protection features are not effective in raising the level of defenses around nuclear power stations.

Throughout the NRC and industry exchange regarding the proposed switch, the manual actions are referenced as being conducted by “operators.” In the event that a significant fire results from a security related event such as a coordinated attack as the United States experienced on September 11, 2001. NIRS contends that the substitution for operator manual actions in lieu of passive fire protection features have not been appropriately evaluated in context of a simultaneous fire and security event.

These concerns are documented in statements made by staff:

*“Throughout the comments on manual actions I see ‘operator(s)’ does this mean that we do not expect nor will we accept a manual action that is dependent on another group as well? Such as a manual action that can only take place after security lets the operator in a room? I am asking this because many manual actions take place in rooms that are secured either with a physical bolt or magnetic lock (cardkey). The bolts are often only unlocked by security and the cardkeys may or may not fail in the locked position (depends on the site). My concern- if it is a time critical activity and there is something going on that causes the security to have to make a priority—what guarantees that unlocking the door(s) will be the first thing done?”<sup>41</sup>*

#### What is the appropriate use of operator manual actions

NIRS is not opposed to the addition of qualified and approved operator manual actions as part of the defense-in-depth strategy for fire protection at nuclear power stations as long as these actions are taken in conjunction with the resumption of compliance and enforcement for maintaining qualified fire barrier systems, minimum separation requirements and detection and automated suppression systems to assure that safe shutdown equipment be maintained free from fire damage.

NIRS would support a rewording of the proposed rule to completely drop new paragraph Appendix R III G.2c-1 and add Appendix R III P to codify the addition of qualified and review able operator manual actions to nuclear power station fire protection programs. The addition of qualified activities would enhance defense-in-depth for fire protection when provided in context with maintaining the qualified fire protection features of Appendix R III.G.2.

Sincerely,

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- <sup>2</sup> “Browns Ferry: The Regulatory Failure,” Union of Concerned Scientists, June 10, 1976
- <sup>3</sup> Report on Browns Ferry Fire, NUREG-0050, U.S. NRC, February 1976, p. 6
- <sup>4</sup> Report on Browns Ferry Fire, NUREG-0050, U.S. NRC, February 1976, p. 6
- <sup>5</sup> “Thermal Barriers and Regulatory Frameworks: the U.S. Experience on Fire Protection,” Dr. Shirley Jackson, Chairman, US NRC, Address at “Fire Safety ‘98”, April 15, 1998.
- <sup>6</sup> 10 CFR 50 Appendix R III.G.2
- <sup>7</sup> “White Paper For Manual Actions,” John Hannon, Chief PSB/DSSA/NRR, US NRC, Letter to Alex Marion, Nuclear Energy Institute, November 29, 2001, Enclosure, FOIA 2003-0358 Appendix D22, p.1.
- <sup>8</sup> “Rulemaking Plan On Post-Fire Operator Manual Actions,” SECY-03-0100, NRC, June 17, 2003, p. 4].
- <sup>9</sup> FOIA 2004-277/ N 73, Email, Galluci, to Bongarra, Manual Actions, 03/04/2004
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- <sup>27</sup> □ “Thermal Barriers and Regulatory Frameworks: the U.S. Experience on Fire Protection,” Dr. Shirley Jackson, Chairman, US NRC, Address at “Fire Safety ‘98”, April 15, 1998.
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