Nuclear Safety and Reactor Cable Separation

The failure of Japan's nuclear regulator

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Greenpeace Japan

In December 2015, the public learned that the Japanese Nuclear Regulatory Authority (NRA) had failed to thoroughly inspect safety-related cables onsite during its restart safety review process. In short, it did not verify whether the cables that provide power to critical equipment and back-up systems were separated – by physical space, fire protective coatings, and/or fire barriers.

In January 2016, the NRA announced that it knew of at least 13 reactors at six nuclear plants in Japan that were in noncompliance with NRA fire regulations for safety-related cables. These include: all seven reactors at Kashiwazaki-Kariwa; Units 3 and 4 at Fukushima Daiini; Unit 4 at Hamaoka; Shika Unit 1; Onagawa Unit 3; and Higashi-dori Unit 1.[1] As a result, nuclear power plant operators were "urged" by the NRA to complete a report on the status of cable safety compliance by the end of March. The Takahama reactors, which are due to restart in late January and early February (as well as the two reactors operating at Sendai) were exempted by the NRA from conducting such an inspection review.

The safety implications of a violation would be enormous.

Nuclear reactors rely on redundancies and back-up systems to ensure safety in the event of an accident. If a singular event can destroy both the primary and the backup safety systems, critical functions, such as reactor cooling, may be lost. In the event control and/or power cannot be regained, the reactor is at risk of a catastrophic accident. In addition to the potential loss of power supplies, and of instrumentation and control cables, there is also a threat that fires or short circuits in closely spaced wires can cause critical equipment to start running when it should not be (such as valves opening and releasing reactor coolant), or fail to run when needed.

According to the U.S. Nuclear Regulatory Commission, even under the assumption of compliance with U.S. fire codes, the risk of reactor meltdown due to fire is approximately equal to all other risks combined.[2]

These risks were dramatically illustrated by the March 22, 1975 accident at Browns Ferry Unit 1 in Alabama. Insulation ignited due to worker error, burning for 7 hours and damaging 1,600 cables in 117 conduits and 26 cable trays; of these, 628 cables were safety related.[3] Due to the lack of cable separation or fire protection, the fire was able to knock out both the primary and backup safety systems, as well as damage instrumentation and control, resulting in a total loss of cooling to the reactor core.[4] Without cooling functions, 13 feet of water in the reactor boiled off. Water levels dropped precariously low, coming within just four feet of exposing the reactor core.[5]

Disaster was held off by this thin margin through manual actions taken by workers while the 15 hours of repairs to restore the cooling system were underway.[6]

In the event that the fire had been caused by an external event or some other mitigating circumstance had prevented worker access or ability to perform these manual actions, or that the repairs had taken longer, the result could have been a core meltdown.

As a result of the Browns Ferry fire, the NRC instituted a number of fire regulations – one key stipulation being that cables that provide power to primary and back-up safety systems must be separated, as must power cables and instrumentation and control cables. This can be done via physical separation, fire retardant coatings, or fire barriers.[7]

The International Atomic Energy Agency (IAEA) also acknowledges the fire hazard posed by reactor cabling, stating:

> ***"Together with liquid hydrocarbons used as fuel and as lubricating and insulating fluids, the large inventories of organic insulated electrical cable constitute a significant source of combustible material in nuclear power plants***."[8]

The IAEA continues:

> "Various design approaches have been taken to limit the significant impact of cable fires. Among these approaches are: protecting electrical circuits against overload and short circuit conditions; limiting the total inventory of combustible material in cable installations; reducing the relative combustibility of cable insulation; providing fire protection to limit fire propagation; and ***providing separation between cables from redundant divisions of safety systems, and between power supply cables and control cables.***"[9]

Japanese nuclear regulation was already decades behind. Under former regulations, fire standards that charged operators with mitigating the risk of fire spreading were interpreted to mean separation (though it was not explicitly stated), but the former Japanese nuclear regulator NISA only required documentation for verification. In July 2013[10], the NRA finally issued a regulation explicitly requiring cable separation under the post-Fukushima guidelines and instituted onsite inspections. However, the implementation of these inspections is incredibly weak. For example, despite the many thousands of cables running throughout a reactor, the NRA only inspected the cabling in one place – the control room itself – at Takahama.[11] Such a spot check would not be sufficient to verify safety-related cable separation to systems relied upon in the event of a fire or accident.

The regulator then exempted the Takahama and the Sendai reactors from providing documentation of the cabling situation onsite.[12]

The NRA is more than aware of the potential problem: an NRA official told the Japan Times in December 2015, "At present, we can't deny the possibility that other cables are mixed at pressurized-water reactors, but how to handle the problem has yet to be decided."[13]

Yet, in spite of this, the NRA is allowing operation and restart of reactors without ever inspecting the majority of the cables for fire safety compliance. To be clear, such inspections are not impossible by any means. For example, the U.S. NRC requires extensive inspections both during construction of reactors and after the work is completed[14], to ensure adequate cable separation.

Additionally, in its discussion of aging-related cable inspections, the IAEA outlines numerous techniques available to inspect both accessible and inaccessible cables.[15]

However, in failing thoroughly inspect the cabling in any reactor for fire safety compliance, as well as the decision to exempt the very reactors that are or will soon be operating from the requirement to show compliance, the NRA has chosen to betray the public trust and ignore its responsibility to enforce safety regulations.

In fact, under questioning from citizens and NGOs at the National Diet on January 21st, an NRA representative admitted that they did not know whether the Takahama reactors are in violation of cable separation fire codes, as they simply had not checked them beyond the control room.

Such a complete regulatory failure on the part of the NRA is not unexpected, given the agency's abysmal track record. But, it does expose the NRA as a weak regulator whose negligence is potentially putting the lives of citizens living in the shadow of reactors in Japan at significant risk.

For further information:

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[1] *"NRA to call for checks of safety-related cables at nuclear plants"*, Jiji. January 6, 2016. The Japan Times. http://www.japantimes.co.jp/news/2016/01/06/national/nra-call-checks-safety-related-cables-nuclear-plants/ - .VqVaFSiyT6h

[2] Jack Grobe, Associate Director for Engineering and Safety Systems, Nuclear Regulatory Commission, Transcript of Nuclear Regulatory Commission Briefing on Fire Protection Issues, July 17, 2008, page 58, states "Approximately one-half of the core damage risk at operating reactors results from accident sequences that initiate with fire events." Sourced: *"NRC's failure to enforce fire regulations."* Union of Concerned Scientists. June 2013. https://s3.amazonaws.com/ucs-documents/clean-vehicles/ucs-nrc-fire-regulations-5-2-13.pdf

[3] Jack Grobe, Associate Director for Engineering and Safety Systems, Nuclear Regulatory Commission, Transcript of Nuclear Regulatory Commission Briefing on Fire Protection Issues, July 17, 2008, page 58, states "Approximately one-half of the core damage risk at operating reactors results from accident sequences that initiate with fire events." Sourced: *"NRC's failure to enforce fire regulations."* Union of Concerned Scientists. June 2013. https://s3.amazonaws.com/ucs-documents/clean-vehicles/ucs-nrc-fire-regulations-5-2-13.pdf

[4] *"NRC's failure to enforce fire regulations."* Union of Concerned Scientists. June 2013. https://s3.amazonaws.com/ucs-documents/clean-vehicles/ucs-nrc-fire-regulations-5-2-13.pdf

[5] Ibid

[6] Ibid

[7] "Appendix R to Part 50—Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979." U.S. Nuclear Regulatory Commission. Appendix R to Part 50—Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979

[8] "Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants." IAEA Safety Standards Series. Safety Guide. No. NS-G-1.7. 2004. Appendix IV: Protection Against Electrical Cable Fires. pgs. 46-48. http://www-pub.iaea.org/MTCD/publications/PDF/Pub1186_web.pdf

[9] Ibid

[10] *"NRA to call for checks of safety-related cables at nuclear plants."* Jiji. January 6, 2016. The Japan Times. http://www.japantimes.co.jp/news/2016/01/06/national/nra-call-checks-safety-related-cables-nuclear-plants/ - .VqOgIlN96Rs

[11] Statement by NRA representative during a meeting at the National Diet members building response to questions from NGOs. https://www.youtube.com/watch?v=m0KsOgTtdIc

[12] Ibid

[13] *"NRA fails to conduct on-site checks for nuclear-plant cables."* December 6, 2015. The Japan Times. http://www.japantimes.co.jp/news/2015/12/06/national/nra-fails-to-conduct-on-site-checks-for-nuclear-plant-cables/ - .VqTjiVN96Rs

[14] Inspection Manuel. INSPECTIONS OF INSPECTIONS, TESTS, ANALYSES AND ACCEPTANCE CRITERIA (ITAAC) RELATED WORK. INSPECTION PROCEDURE 65001. U.S. Nuclear Regulatory Commission. *"INSPECTION OF ITAAC-RELATED INSTALLATION OF ELECTRIC AND FIBER OPTIC CABLE"* ATTACHMENT 65001.09. See, http://pbadupws.nrc.gov/docs/ML1318/ML13182A233.pdf. See also, http://pbadupws.nrc.gov/docs/ML0833/ML083300076.pdf

[15] Nuclear Energy Series. *"Assessing and Managing Cable Aging in Nuclear power Plants."* International Atomic Energy Agency. pgs. 35-60. http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1554_web.pdf