In Re: G20090007, Petition for Mitigation of Volcanic Ash Impacts to All U.S. Reactors

Dear Petition Review Board:

Summary

The initial petition for mitigation of volcanic ash impacts to all U.S. reactors from the Yellowstone Supervolcano was amended at the PRB hearing to encompass potential impacts from any and all sources of volcanic ash as they may adversely affect reactor operations. Where all sources of volcanic ash must be considered, the initial question must shift from the probability of eruption of U.S. Supervolcanoes to one of assessment of the potential adverse effects of air and water borne ash on reactor operation due to the fact that there are many historically eruptive volcanoes in the Cascade Range that could produce ash clouds that would reach existing and proposed reactor locations. Document production requests show that no such NRC evaluation of this hazard to reactor operation has been undertaken to date and the PRB must therefore require commissioning of a comprehensive assessment of potentially adverse impacts from ash to reactor mechanical and electrical systems to determine whether the historically eruptive volcanoes could produce either hazardous airborne or waterborne ash concentrations that requires mandatory mitigation protocols for specific facilities within Cascade Range Volcano ash fall.

Where such an evaluation shows adverse ash effects warranting mitigating action, a deterministic evaluation of the potential for Supervolcano eruption at the Yellowstone, Long Valley and Valles Calderas, and the distribution of ash there from, simply affects the number of reactors that must adopt and implement appropriate ash mitigation procedures in advance of eruption or when threatened, as mitigation time frames may allow. It is Petitioner's position that, although long dormant, the Yellowstone and Long Valley Calderas continue to exhibit most, if not all, of the deterministic parameters listed in Table 5.1 of B. E. Hill's paper for assessment of active volcanic systems that require the inclusion of their potential ash cloud distribution for determination of which reactors should be ordered to adopt and employ ash mitigation protocols. Given that the effect of the Jet Stream on creation of tephra deposits from prior Supervolcano eruptions is unknown, it is very likely that proper atmospheric modeling will show that all U. S. reactors could be enveloped in ash clouds that could adversely affect their safe operation. Moreover, if the greater effects of Supervolcano eruption as a whole are considered, the ability of reactors to be safely operated or decommissioned in the face of a failure of civilization itself must be considered beyond the more obvious direct ash effects.

Examination of Potential Adverse Effects of Ash on Reactor Operation

The presented documentation establishes a wide range of hazards associated with volcanic ash that the PRB must fully examine, well beyond the limited understanding and assertions of this Petitioner. Of particular concern to reactors is the fact that fine particles of very hard volcanic ash presents an abrasion and corrosion hazard to virtually all mechanical equipment that is not totally sealed against its intrusion into working mechanisms. Ash deposited on wires, power

systems and electronic equipment can cause short circuits, particularly when moist or wet. Ash introduced into cooling/process water may abrade or otherwise impair operation of pump impellers, turbine blades, valves, etc. and cause premature failure at high pressure/high flow locations in piping. Sedimentation in primary cooling loops could potentially cause critical cooling problems, mechanical impairment of critical components including control rod operation and abnormal neutron flux densities. The supplied FOIA response establishes that the NRC has not examined these threats to reactor operation to any degree or at any stage of reactor licensing despite a number of West Coast reactors being in range of ash fall from a number of Cascade Range Volcanoes that have erupted numerous times within recorded history and remain active.

One or more of the above cited potential ash hazards would likely cause the cessation of reactor power operations due to the inability to transmit/dissipate generated power/heat and/or to prevent damage to the power generation system and/or reactor core. While reactor shut down would certainly lessen the potentially adverse ash effects, the latent heat of radioactive decay in the core would still necessitate power access/generation for operation of cooling pumps to remove heat from fuel rods up to 7% of the plant thermal output. Stored spent fuel rods may also need water circulation or at least evaporated water replacement.

Both primary and secondary water sources may well be critically contaminated with ash such that neither water source could be used in the primary cooling loop for blow down replacement and would otherwise threaten reliable operation of water pumps and piping in the secondary cooling loop. Given the deleterious effects of ash, it may be necessary to require exclusion of ash from secondary cooling sources used to qualify for the ultimate heat sink, (e.g. pond covers), or creation of a tertiary source of clean water, (i.e. high volume water wells and/or fully contained storage). The covering/containment of secondary cooling ponds would affect its heat dissipation properties where water is re-circulated and flexible pond coverings may not otherwise be practical if heavy loads of wet ash are possible. Another alternative mitigation measure might entail installation of water filtering systems to remove the very fine ash, but filtering systems would certainly have to be extremely large to provide the needed flow rate and to prevent clogging by the fine ash. If cooling needs are limited, (i.e. restrictions on fuel age), it may be possible to use ash contaminated water to some extent if circulation is isolated to the heat exchanger in the secondary cooling loop, sufficient redundant pumps are readily available, and the affected piping could withstand the anticipated abrasion and corrosion effects, (i.e. flow rates and pressures will likely have to be restricted). Whatever ash concentration/filtering is deemed acceptable for the secondary cooling loop or auxiliary generators, it seems certain that an inviolable clean water source to replace worst case primary loop blow downs would be necessary to insure reliable operation of critical reactor core components, particularly control rods and primary loop pumps, and to avoid disassembly of the core/primary loop to remove ash deposits prior to renewed power production.

On site auxiliary generators and power cables needed to run these cooling pumps, (it must be assumed that grid power is shorted out by wet ash), would have to be isolated from any possible

ash contamination to ensure reliable operation, (e.g. multiple/regenerative fine filters for air and fuel supply and well water/stored water for cooling). The generator building should also be sealed and filtered to the maximum extent practicable to prevent ash contamination of air-exposed moving generator parts and circuitry. Manual control of these auxiliary systems should be available in the event of compromise of the main control room by ash.

Probability of Ash Contamination

The paper of Dr. Hill regarding assessment of volcanic hazards, the referenced paper on siting of the Javanese reactor and the email from Dr. Lowenstern all suggest that the PRB should consider a broad range of deterministic factors in addition to any probabilistic analysis of eruptive events when considering the threat from any volcanic system. Consideration of deterministic factors is recommended because it would be grossly negligent to ignore known indicators of volcanic activity and eruption precursors when assessing the potential of future hazards from volcanoes. Many of the cited Cascade Volcanoes and Supervolcano Calderas exhibit recent and re-occurring symptoms of volcanic activity such as ground deformations, deep magma influx/flow, persistent and severe seismic activity, magmatic gas releases, hydrothermal activity and other known features of active volcanic systems. Although Dr. Lowenstern would be the first to retort that these are not necessarily indications of an imminent catastrophic eruption of Yellowstone, his supplied email also recommends that major facilities such as nuclear plants prepare in advance of such an event given the uncertainty in predicting Supervolcano eruptions and the potential consequences of being caught unprepared with potentially little warning. Given this advice from this leading government authority, the Director of the Yellowstone Volcano Observatory, it is incumbent upon the PRB to order development of ash mitigation plans for all existing and proposed reactors within the reach of a Yellowstone eruption. Deep Yellowstone tephra deposits extend from the West Coast to the Mississippi River and from our Northern to Southern Borders. Although Petitioner is not a meteorologist, it doesn't take a high degree of sophistication to soundly postulate that the Jet Stream could cause deposition of significant ash from such an eruption along multiple segments of the East Coast as well, given variable Jet Stream course tracks at the time of potentially prolonged eruptive events.

Whether or not the PRB adopts the expert recommended approach for use of deterministic factors for assessing potential volcanic hazards, the strictly probabilistic assessment of hazards from Cascade Volcanoes are sufficient to trigger a full investigation of ash hazards and mitigation protocols for the reactors within range of the ash clouds from these volcanoes. The attached DOE hazard assessment protocol minimally requires consideration of hazards from volcanoes that have erupted within the Quaternary Period. Where specific ash hazards are established by this investigation, it would be sheer folly not to fully advise and recommend adoption of hazard mitigation protocols for reactors well beyond the range of the Cascade Volcanoes. If however, the PRB adopts consideration of the deterministic approach establishing any of the three cited supervolcanoes as an active volcanic system and potential source of ash, both the range of effects and degree of hazard will be greatly increased to match the

exponentially increased amount of ash that could be generated by a Supervolcano. The more acute direct and chronic indirect effects of that ash volume in the atmosphere and surface waters as well as on access roads, facility grounds and structures would certainly require additional mitigation protocols beyond that required for response to Cascade Range Volcano eruptions. Most volcanologists studying such prior super-eruption events suggest that civilization could potentially collapse from worldwide failure of food crops over multiple years due to blockage of insolation and that would require extensive mitigation protocols far beyond the acute needs of securing a suitable ultimate heat sink and protecting components from abrasion/corrosion damage associated with the much lighter Cascade volcano ash fall.

Although Petitioner has received a copy of the transcribed teleconferenced hearing, he has not had an opportunity to fully review the transcript for errors. He however recalls that he had quoted the USGS chief volcanologist regarding the most analogous monitored volcanic eruption to a Supervolcano eruption but the USGS volcanologist was not Director Myers but Chief Volcanologist John Eichelberger, (703 648 6711 jeichelberger@usgs.gov), who was assigned to address Mr. Lakosh's concerns by Director Myers. Petitioner hopes to review and correct the transcript within the next few weeks, but the testimony, as recollected, is otherwise accurate.

Sincerely, Tom Lakosh