Review of the August 1, 2005 Draft Report "Amchitka Independent Science Assessment: Biological and Geophysical Aspects of Potential Radionuclide Exposure in the Amchitka Environment"

Introduction

This is a review of the August 1, 2005 draft report "Amchitka Independent Science Assessment: Biological and Geophysical Aspects of Potential Radionuclide Exposure in the Amchitka Environment," which was prepared by the multi-university Consortium for Risk Evaluation with Stakeholder Participation (CRESP). The review presented herein was performed by a subcommittee (Table 1) of the CRESP Peer Review Committee, at the request of the Consortium's leadership. The subcommittee's evaluation of the draft report is set forth in the remarks that follow.

General Comments

This is a comprehensive, well organized, and well written report on the rationale, objectives, methodology, and results of an investigation into the extent to which radionuclides released in underground nuclear detonations on Amchitka Island decades ago may be found to have contaminated the surrounding environment, ecosystem, and associated food chain. The investigation was undertaken by CRESP to address concerns of major importance to those who subsist on the local marine forms and other wildlife, to commercial fishermen and consumers of the fish and other marine organisms harvested locally, to the various governmental agencies concerned with the health and safety of the region, and to environmentally conscious citizens elsewhere.

The report is voluminous, but its length is amply justified in view of the multidisciplinary scope and logistical complexity of the investigation. The studies in question involved the coordinated efforts of participants drawn from different governmental organizations, universities, and stakeholder groups, collaborating in three separate sea-going expeditions into a cold, remote region of the Aleutian chain. In order for each aspect of the inter-related studies to be described and documented adequately, it needed to receive the space given to it in the report.

The investigation focused appropriately on two main study areas: the geophysical and the biological. In the geophysical study area, the major research tasks that were undertaken included the acquisition and analysis of relevant oceanographic and bathymetry data, and studies to determine: 1) whether there is evidence of the local discharge of freshwater into the ocean floor, 2) whether there is accumulation of sediment, and 3) the depth of the freshwater-saltwater interface in the groundwater below each shot cavity. In the biological study area, the main tasks included the collection and radionuclide analysis of samples of local marine biota, sea birds, fish, algae, and other organisms collected at several trophic levels in the food chain and at different stations on land and at various depths of the sea around the three test shot areas on Amchitka and also around Kiska, another Aleutian island which was selected as a reference.

The research methods that were used to accomplish the aforementioned tasks, the processes by which they were selected and applied, and the results that they yielded are clearly described in the report. In essence, the methods appear to have been well conceived, expertly applied, and to have produced results that are definitive and thereby enabled conclusions that should be meaningful to all concerned.

In brief, the salient conclusions emerging from the investigation can be summarized as follows: 1) no evidence of seepage of radionuclides from the shot cavities on Amchitka into the surrounding marine environment was detectable; 2) the levels of radionuclides in biota present in the benthic and intertidal habitats around Amchitka were within the range found in biota from other marine environments in the Northern hemisphere and well below levels known to pose risks to human health or to other organisms or ecosystems; 3) salinity measurements revealed no substantial discharge of freshwater through the ocean floor, such as might indicate the existence of a preferential pathway for migration of contaminants from a test shot cavity; and 4) the ocean floor in the region of the Cannikin and Long Shot test sites contains significant accumulations of sediment, which have the potential to accumulate certain contaminants and which, therefore, underscore the need to monitor sedentary biota that may take up such contaminants in the future.

In view of the high quality of the studies reported and their failure to detect evidence of the release of radioactivity from the shot cavities into the surrounding environment, the results that are presented should be reassuring to concerned stakeholders. The investigators are to be commended for the excellence of their work and for their nimble adaptations to the challenges presented by field conditions and by the need to scale back their efforts to match the available resources. Also, to the extent that future monitoring efforts at Amchitka are called for, the findings presented in this report should provide useful guidelines to those who may be involved in such efforts.

Specific Comments

Acknowledgements (pp.v-vi): in merely listing those who have participated in the various aspects of the report, without identifying their roles in all cases or thanking them for their contributions, this section should not be labeled “Acknowledgements”. Also, the fact that Upton is listed twice - both as a member of the CRESP Team and as the Chairman of the Peer Review Subcommittee – could cause many readers to be confused about his role.

Glossary (pp. x-xii): this is a reasonably complete and useful addition to the report, but the following need correction and/or clarification.

p. xi: deleted uranium is NOT what remains after fission but what remains after enrichment. It is this U, mainly 238, that is used in armor-piercing shells.

p. xi: Plutonium is not “widely used” in reactors, other than breeders. It is true that U238 in reactor fuel does capture neutrons and transmute to Pu that is then burned.

p.xii: Uranium 235 "is used in nuclear weapons, research reactors, and nuclear power reactors."

List of Abbreviations (p xii): this list is helpful but could be greatly improved by the inclusion of additional abbreviations and acronyms, such as NMFS, CTD, QINSy, etc.

Executive Summary (pp.xiii-xvi): this is an appropriately succinct, clear, and inclusive summary of the report; however, the following need further discussion and/or clarification.

pp. xiv: there should be more discussion of why water and air samples were not included.

p. xiv, 3rd paragraph: the difficulties resulting from DOE's classification of nuclear test materials associated with Long Shot, Milrow, and Cannikin, briefly mentioned on p. 11.33, should be discussed further.

p. xiv, last sentence of item 2: this is the only statement that implies the existence of a real hazard. How likely is contaminated seepage that could lead to bioaccumulation and biomagnification?

Introduction (pp.1.1-1.3): this section clearly and briefly explains the origin, institutional framework, budget, personnel, and scientific objectives of the Amchitka Independent Science Assessment, thus placing the report in proper perspective for the reader. Extensive additional, amplifying information is provided in the companion appendices.

Background on Amchitka (pp.2.1-2.16): this section is helpful in briefly reviewing the relevant geography, physical characteristics, ecology, and history of Amchitka, with particular reference to the nuclear tests conducted there during the period 1965-1971, potential pathways for movement of radionuclides from the resulting shot cavities to the surrounding environment and to the sea, contaminant receptors of concern, and data on the levels of radioactive contaminants found by previous investigators to exist in such receptors at Amchitka, as compared with those in comparable species in the marine environment at large. The compilation of the latter that is contained in the accompanying appendix (2.A) is particularly relevant and informative.

Apart from the need to clarify the statement about the Cannikin mined shaft on page 2.5 and to add the missing reference to "Younker 2002" cited on page 2.6, line6, the section and its accompanying appendix are amply clear and informative.

p. 2.2: whales and seals are mentioned here and elsewhere in the report, but analytical data on them are not included; were they not sampled? If not, why not?

P. 2.5, lines 5-6: the word "cavity, as used here," can be misunderstood to mean "after-shot cavity," the diameter of which greatly exceeds 52 feet, as indicated in Figure 2.2. For this reason the word "shaft" would be preferable here.

P. 2.6, 3rd paragraph, line 5: the reference "Upton, 2003" is missing from the Bibliography.

p. 2.8, 2nd paragraph: what were the effects of DOE's classification of relevant scientific data?

Conceptualization of Amchitka Field Work (pp. 3.1-3.25): This section explains the rationale underlying the research priorities and research strategies that were adopted for the biological and geophysical studies in question, given the relevant budgetary and time constraints. It is informative in describing and highlighting the manner in which iterative multidisciplinary interactions were important in the planning, execution, and integration of the studies.

The first few pages go into great detail on how the funds were only one-third of what was in the original plan. There is only a one-sentence mention of this in the Summary (p. xiii). The paragraph on p. 3-20 on Sediment and Water Sampling is a clear indication of the damage done to the study plan by the funding reduction; however, after so extensive a discussion of the shortfall, the report should be more explicit as to what could not be done and should discuss how its omission can be expected to affect the validity of the conclusions. Either too much money was requested, or this report should include caveats.

Mounting an Expedition (pp. 4.1- 4.23): This section, with its appendices, consists largely of a discussion and documentation of the organizational and logistical issues that confronted the investigators and how each of these issues was successfully addressed. It is a clearly written and interesting review of the many diverse problems encountered in mounting and conducting the expeditions that were required, and it is an instructive account of the manner in which the various obstacles were overcome.

Geophysical Investigations I: Oceanographic Investigations of Bathymetry, Ocean Floor Discharge of Freshwater through the Ocean Floor and Sediment Distribution (pp. 5.1-5.15): this section describes the geophysical and hydrologic studies carried out to determine whether there is evidence of the discharge of freshwater from the shot cavities through the ocean floor at those ocean depths and locations where such discharge is most likely to have occurred, and to explore for evidence of sediment accumulation on the ocean floor off-shore from the shots. The methods and findings are presented in detail and are well documented.

p. 5.8, fig. 5.6: it would be helpful to indicate the sites of the explosions on this diagram.

Geophysical Investigations II: Magnetotelluric Measurements for Determining the Surface Salinity and Porosity Structure of Amchitka Island, Alaska (pp. 6.1-6.27): this section reviews the magnetotelluric methods and models that were used to determine the depth of the freshwater-saltwater interface at each test shot, to ascertain whether subsurface features associated with the underground nuclear testing could be imaged with magnetotelluric methods, and to determine whether faults could be detected through their

effects on groundwater flow. With its accompanying appendix, the section describes in ample detail the methods that were used and the results that were obtained.

p. 6.2: the table describes fresh water as having a chloride concentration of < 700 g/liter and pure salt water as having a concentration of 19.3 g/liter – i.e., salt water has a concentration 35 times LESS than fresh water?

p. 6.7, next-to-last paragraph, line 10: is the term "misfit"appropriate? The report here states, "a value in the range of 1-1.5 is generally considered acceptable. The value for the model is given as 0.818. Is this then unacceptable?

Characterization of Amchitka Island Subsurface: Groundwater Modeling in the Vicinity of the Long Shot Test (pp. 7.1-7.21): this section is clearly written and well focused on the relevant issues. The finding that radionuclide levels in the sea waters around Amchitka have not been significantly affected by any possible releases from the three underground tests is in agreement with the extensive series of investigations of the consequences of the French underground testing in French Polynesia. Lacking, however, is any reference to the fact that studies of underground nuclear testing on the island of Mururoa in French Polynesia (published by the International Advisory Commision in a six-volume report "The Radiological Situation at the Atolls of Mururoa and Fangataufa," available from the IAEA) have indicated that thermal plumes created by the explosions can have important effects on the groundwater flow and the transport of radionuclides from the explosion cavities to the ocean. Such studies have indicated that the underground explosion initially drives water out of the vicinity of the explosion cavity, and that when the pressure within the cavity subsequently drops (within some hours) a collapse chimney forms above the cavity, rubble falls into the cavity, and water starts to flow back into the resulting high-porosity volume. The water in this collapse volume is heated by the hot rock and gases in the cavity, so that a convection cell of hot water rises in the chimney, replaced by colder water at the bottom. The thermal effects decay at a rate that was calculated to vary inversely with the yield of the bomb, such that the heat from a 150kt weapon could be expected to take tens of years to dissipate. Although the geology and permeabilities of the rock on Amchitka may differ from those on the atoll of Mururoa, one must consider the possibility that the perturbation in groundwater flow due to the explosions (and resulting convection cells) is still sufficiently pronounced on Amchitka today, given the large yields of the bombs that were exploded there, so that groundwater does not flow from the resulting explosion cavities to the ocean, and marine biota may not be contaminated until some time in the future.

Characterization of the Biological Expedition and Sample Preparation Phase (pp. 8.1-8.20): This section, which presents detailed information on the biological expedition and sample preparation, is well organized and clear.

Selecting Species and Radionuclides for Assessment (pp. 9.1-9.21): this section presents and discusses the overall radiological analysis plan, the radiological assay methods to be employed, the radionuclides to be assayed, the species of biota, foodstuff,

and other materials to be sampled for evaluation, and the numbers, types, sizes, and locations of the specimens to be obtained. The information is well organized and well presented.

Biological Collections from the Marine Ecosystem (pp. 10.1-10.16): this section is well written, clear, and informative In general, however, the Reference Site needs a more concentrated and comprehensive discussion than it is given here and elsewhere in the report.

p. 10.1, next-to-last paragraph, lines 3-5: "significant differences in the sizes …caught by the scientists and Aleut fishermen" may be attributable merely to different methods of collection but deserves comment, since "significant" is an eye-catching term.

p. 10.14, Table 10.2: the nomenclature used in this table needs to be clarified.

Radionuclides in Marine Biota (pp. 11.1-11.45): in this section the results of radiological assays of marine biota are presented in detail. The results, which show no evidence of radionuclide contamination from the shot cavities, are well documented and definitive.

p.11.2, second from last paragraph: this paragraph notes that the Science Plan was refined using suggestions from the stakeholders, who include the Native communities and the state. Since the funding allowed only about one-third of the Plan to be done, how is this shortfall being explained to the stakeholders? In particular, are there any issues about which the stakeholders had strong requests to be done that were not done? This should be discussed since so many Native communities and state officials do not trust the federal government and are prepared to mistrust work done under contract to a federal department. This concern is strengthened by the comment on p.12.23 under (3) where "palpable stakeholder concerns" are described as not being able to be addressed. Page 12.26 also mentions two issues "of such clear concern to stakeholders."

p. 11.9: the paragraph under the picture notes that the suite of isotopes was reviewed by people "whom we expected to provide advice if our selection list was missing key isotopes." The report should give the results of that review.

11.10: paragraph above the table notes, "due to time and money constraints not all samples could be analyzed for all radionuclides." This is another example of a potential weakness in the study due to funding cuts.

11.12, first paragraph: this reads as though for data analysis, if a radionuclide could not be detected, its value was included as one-half the MDA. This does not seem to be a sound approach.

p. 11.26, Table 11.11: where is the entry for footnote "d"?

p. 11.30, 1st sentence: the statement that "the present study did not sample food" is confusing in view of the fact that many of the samples consisted of fish or other food stuff.

Implications for Groundwater Models, Risk Evaluations, Future Biomonitoring and Long-Term Stewardship at Amchitka Island (pp. 12.1-12.27): This is a thoughtful discussion of the questions relevant to the long-term stewardship of the island that remain to be answered, and of the kinds of research needed to address these questions. Its conclusions and recommendations are well reasoned, clearly stated, and should provide valuable guidance for the future.

P.12.6, last line: the reference "NRC 2005" is missing from the bibliography.

Editorial Comments

p. x: the entry for "Cesium" repeats a sentence and is garbled.

p. xi: the definition of "MDA" is missing.

p. 2.16, 1st line: "cs-137" should be "Cs-137."

p. 2.16, Table 2.3: "Bz/kg" should be "Bq/kg."

p. 3.6: the last sentence of the footnote is garbled.

p. 8.12, Table 8.1, Footnote b: where is the entry for Norway rats in the table?

p. 8.18, 3rd line from bottom: "their" should be replaced by "its."

p. 11.14, Table 11.3: the footnotes in this and other tables should be cited in order.

p. 11.36, Table 11.13: where is the entry for footnote "b"?

p. 11.38, Table 11.15: footnote "c" needs to be defined.

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