



U.S. DEPARTMENT OF  
**ENERGY**

# Impact of Climate Change on Runit Dome in the Marshall Islands

Report to Congress  
July 2024

United States Department of Energy  
Washington, DC 20585

# Message from the Secretary

The Department of Energy (DOE) is committed to fulfilling the United States' commitments to the health and safety of the people of the Marshall Islands from the effects of the nuclear weapons testing conducted in the past.

This is the DOE Report to Congress regarding the impacts of climate change to Runit Dome in the Marshall Islands, as outlined in Section 3140 of Public Law 117-81, *National Defense Authorization Act for Fiscal Year 2022*.

Pursuant to statutory requirements, this report is being provided to the following members of Congress:

- **The Honorable Jack Reed**  
Chairman, Senate Committee on Armed Services
- **The Honorable Roger Wicker**  
Ranking Member, Senate Committee on Armed Services
- **The Honorable Angus King**  
Chairman, Subcommittee on Strategic Forces  
Senate Committee on Armed Services
- **The Honorable Deb Fischer**  
Ranking Member, Subcommittee on Strategic Forces  
Senate Committee on Armed Services
- **The Honorable Mike Rogers**  
Chairman, House Committee on Armed Services
- **The Honorable Adam Smith**  
Ranking Member, House Committee on Armed Services
- **The Honorable Doug Lamborn**  
Chairman, Subcommittee on Strategic Forces  
House Committee on Armed Services
- **The Honorable Seth Moulton**  
Ranking Member, Subcommittee on Strategic Forces  
House Committee on Armed Services

If you have any questions or need additional information, please contact me or Mr. Brian Eiler, Deputy Assistant Secretary for Senate Affairs or Mr. Eric Delaney, Deputy Assistant Secretary for House Affairs, Office of Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

A handwritten signature in black ink, appearing to read "J. Granholm", with a stylized flourish at the end.

Jennifer M. Granholm

## Executive Summary

This is the United States (U.S.) Department of Energy (Department or DOE) Report to Congress regarding the impacts of climate change to the Runit Dome in the Republic of the Marshall Islands (RMI) as outlined in Section 3140 of Public Law 117-81, *National Defense Authorization Act for Fiscal Year 2022*.

The Runit Dome<sup>1</sup>, located in the Enewetak Atoll on Runit Island, contains radioactively contaminated soil and debris that was placed inside an unlined nuclear weapons test crater during cleanup operations performed by the U.S. in the 1970s and covered by a non-load bearing concrete cap. The RMI government maintains Runit Island as an indefinitely off-limits location due to the residual sub-surface levels of radioactive contamination. Access or visitation is restricted to official activities.

The study, independently conducted by the DOE Pacific Northwest National Laboratory (PNNL), assessed how climate change could affect the potential release or redistribution of radionuclides from the Enewetak lagoon, island land surfaces, and the Runit Dome site (including a hypothetical failure of the containment structure) and the subsequent impacts to Enewetak Atoll residents and environment. The study did not assess the effects of any other toxins nor determine reasons for the hypothetical failure of Runit Dome. Radionuclide data was derived from past studies; no new radiochemical sampling or analyses were performed. As mandated by Public Law 117-81, a draft of the report was published for public comment for 60 days resulting in 30 comments that were addressed by PNNL within the final report.

PNNL determined that storm surge coupled with gradual sea level rise would have the most influence on the mobilization and transportation of radionuclides throughout the atoll. Storm scenarios were developed based on historical storms and accepted weather and global climate models. The study estimated radiation exposure for nine potential scenarios for current conditions and those postulated for 2090 including a hypothetical failure of Runit Dome.

For storm scenarios where Runit Dome remains intact, changes in contaminant radiological doses are estimated to be below 0.1 mrem/year for all islands. With a hypothetical failure of Runit Dome, radiological doses are estimated to be below 0.2 mrem/year for all inhabited islands. Even smaller changes were estimated for lagoon biota. The overall low radiation exposure is due to storm redistribution of radionuclides to deeper waters providing increased distance, shielding, and dilution and for future scenarios, radioactive decay.

An increase in radiological dose of approximately 20 mrem could accumulate in areas around the Runit Island in the first year following a hypothetical failure of the dome. Radiological doses to lagoon biota would temporarily increase but were estimated to be approximately 500–1000 times lower than the action levels recommended by U.S. and international agencies and organizations.

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<sup>1</sup> The Cactus Crater waste containment structure on Runit Island is located on Enewetak Atoll and is referred to colloquially as “Runit Dome.” In the appended report, the two terms are used interchangeably.

The results of the PNNL study, combined with data from ongoing DOE environmental monitoring programs, indicate no potential for increased health risks to residents of inhabited islands in the Enewetak Atoll from current or future conditions considering the impacts of climate change, including a hypothetical failure of the Runit Dome. Estimated changes in radiological dose for all postulated scenarios to aquatic biota in the lagoon are not anticipated to impact the health and diversity of the environment of the Enewetak Atoll. Additionally, the results indicate the Runit Dome does not represent a significant source of radiation exposure relative to other sources of residual radioactive contamination and naturally occurring radiological sources on the Enewetak Atoll.



# Impact of Climate Change on Runit Dome in the Marshall Islands

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# I. Legislative Language

Section 3140 of Public Law 117-81, *National Defense Authorization Act for Fiscal Year 2022*, states:

***“SEC. 3140. STUDY ON RUNIT DOME AND RELATED HAZARDS.***

*(a) STUDY.—Not later than 60 days after the date of enactment of this Act, the Secretary of Energy shall seek to enter into an agreement with a federally funded research and development center to conduct a study on the impacts of climate change on the “Runit Dome” nuclear waste disposal site in Enewetak Atoll, Marshall Islands, and on other environmental hazards due to nuclear weapons testing in the vicinity thereof. The report shall include a scientific analysis of threats to the environment and to the residents of Enewetak Atoll, including—*

- (1) the “Runit Dome” nuclear waste disposal site;*
- (2) crypts used to contain nuclear waste and other toxins on Enewetak Atoll; and*
- (3) radionuclides and other toxins present in the lagoon of Enewetak Atoll.*

*(b) PUBLIC COMMENTS.—In conducting the study under subsection (a), the federally funded research and development center shall solicit public comments.*

*(c) REPORT.—Not later than 18 months after the date of the enactment of this Act, the Secretary shall submit to the congressional defense committees a report containing the study conducted under subsection (a).”*

## II. Introduction

This is the United States (U.S.) Department of Energy (Department or DOE) Report to Congress regarding the impacts of climate change to the Runit Dome in the Republic of the Marshall Islands (RMI) as outlined in Section 3140 of Public Law 117-81, *National Defense Authorization Act for Fiscal Year 2022*.

The RMI is located approximately 2,300 miles west of Hawaii in the northwest Pacific Ocean. Between 1946 and 1958, the U.S. conducted nuclear weapons testing in the Marshall Islands, many at the Enewetak Atoll in the northern and northeastern islands. In the late 1970s, the U.S. performed cleanup operations at Enewetak. The Runit Dome, situated on Runit Island in the northeast section of Enewetak Atoll, contains radioactively contaminated soil and debris that was placed inside an unlined nuclear weapons test crater and covered by a non-load bearing concrete cap during cleanup operations performed by the U.S. in the 1970s. The Runit Dome is approximately 114 meters (374 feet) in diameter and has an apex of 7.4 meters (24.3 feet). The

RMI government maintains Runit Island as an indefinitely off-limits location due to the residual sub-surface levels of radioactive contamination. Access or visitation is restricted to official activities. Upon completion of the environmental cleanup program in 1980, the people of Enewetak Atoll were permitted access to the habitable islands of the Atoll. Only Enewetak Island, which is about 13 miles from Runit Island, is currently inhabited by approximately 275 people.

This report contains a description and summary of findings of the study independently performed by the Pacific Northwest National Laboratory (PNNL), a Federally Funded Research and Development Center under contract to DOE, to meet the requirements of Section 3140 of Public Law 117-81, *National Defense Authorization Act for Fiscal Year 2022*. The final report of the study, *Impacts of Climate Change on Human Health and the Environment in the Enewetak Atoll*, is included as an appendix.

### **III. Assessment**

#### **A. Study Scope and Description**

The study conducted by PNNL assessed how climate change could affect the potential release or redistribution of radionuclides associated with nuclear weapons testing from the Enewetak lagoon, island land surfaces, and Runit Dome site (including a hypothetical failure of the containment structure) and the subsequent impacts to Enewetak Atoll residents and environment. The study did not assess the effects of any other toxins as records of any toxins present in Enewetak lagoon or Runit Island, other than radionuclides, were not available for inclusion in the study. Also, determining reasons for events leading up to a hypothetical failure of Runit Dome were not included in the scope of the study. Radionuclide data was derived from past studies completed by the U.S. and RMI Government and independent researchers. The study did not include new radiochemical sampling and analyses because existing radiochemical data was sufficient to provide the required study analysis. The contribution of the radiological inventory contained in “crypts” or “antechambers” outside the Runit Dome containment structure are included in the analyses of the study.

The study determined that storm surge coupled with gradual sea level rise would have the most influence on how radionuclides could be mobilized and transported throughout the local environment and to human receptors. Storm scenarios for current and future events were developed based on data from three of the most historically severe storms observed in the region and currently accepted weather and global climate models. The study estimated radiation exposures for nine potential storm scenarios — six scenarios based on three different storm strengths using climate conditions for 2015 (the most recent observations available) and 2090 where Runit Dome remained intact; and three worst-case scenarios based on three different storm strengths using climate conditions for 2090 where the Runit Dome failed and released its entire contents to the surrounding area. Conditions for the postulated 2090 storms predicted a 62 cm (24.4 in.) rise in sea level from current levels. Human and biota radiation dose levels were estimated for each of the nine storm scenarios for receptors at 31 islands within the Enewetak Atoll and compared to current atoll radiation dose levels and U.S. and RMI radiation standards/guidance for the general public and environmental exposures, respectively.



Upon completion, Marshallese and English versions of the draft study report were made available for public comment on the PNNL website. The comment period, initially set to 30 days, was extended to 60 days to ensure a maximum level of participation. Notices of the draft report and solicitation of comments were placed in the Marshall Islands Journal and U.S. news outlets where Marshallese citizens are known to reside, as well as several social media outlets. Links to the draft report and public comment website were sent directly to the RMI National Nuclear Commission, the U.S. Embassy in RMI, Enewetak leadership, and the RMI Environmental Protection Authority. Additionally, DOE staff distributed flyers advertising the public comment period while visiting the Marshall Islands. A total of 30 comments were received and addressed.

## **B. Study Findings**

The primary radioactive contaminants that remain in the environment from nuclear weapons testing include the fission products cesium-137 ( $^{137}\text{Cs}$ ) and strontium-90 ( $^{90}\text{Sr}$ ), as well as plutonium (Pu) isotopes ( $^{239}\text{Pu}$  and  $^{240}\text{Pu}$ ), and americium-241 ( $^{241}\text{Am}$ ). These radionuclides are relatively immobile in the soils throughout the atoll. The study confirmed that radioactivity associated with lagoon sediments remains the largest long-term source of radioactive contamination at the Enewetak Atoll.

Radiation exposures attributable to residual contamination in Enewetak Atoll for 2015 were estimated to range from 2.7–1,386 mrem/year accounting for both terrestrial and aquatic exposure pathways. Radiation exposures attributable to residual contamination in Enewetak Atoll for 2090 were estimated to range from 1.4–194 mrem/year accounting for both terrestrial and aquatic exposure pathways. It is important to note that exposure estimates are in addition to exposure from natural radiation sources in the Marshall Islands, which is estimated to be approximately 730 mrem/year. The higher exposures are associated with the northeastern to northern islands while the lower exposures are associated with the southeastern and southern islands. Estimated baseline radiation exposures for 2090 are less than 2015 exposures due to radioactive decay and redistribution of radionuclides to deeper parts of the lagoon and ocean resulting in increased distance, dilution, and shielding. For perspective, the current average radiation exposure from natural sources in the United States is estimated to be approximately 310 mrem/year but is highly dependent on location.

For the 2015 and 2090 storm scenarios where the Runit Dome remains intact, changes in radiological doses from contamination are estimated to be below 0.1 mrem/year and any additional risk to residents of inhabited islands is significantly less than that from naturally occurring environmental radionuclides. Furthermore, many of the islands are estimated to see a reduction in radiation exposure due to storm redistribution of radionuclides to deeper parts of the ocean and lagoon. Even smaller changes were estimated for lagoon biota.

For the 2090 storm scenarios where the Runit Dome fails, releasing the entire radiological inventory, incremental changes in radiological doses from contamination on islands other than Runit Island are estimated to be below 0.2 mrem/year compared to baseline conditions. Similar to scenarios without Runit Dome failure, many of the islands are estimated to see a reduction in radiation exposure due to storm redistribution of radionuclides and radiological doses are

anticipated to decline as the remaining radiological inventory naturally decays and is further distributed by ocean currents and weather patterns.

An increase in radiological dose of approximately 20 mrem could accumulate in areas around the Runit Island in the first year following a hypothetical failure of the dome. Although the study hypothesized a scenario with a much higher radiological dose during the first year following a failure of the containment, the scenario is not realistic as it assumes there are inhabitants on Runit Island consuming locally grown or harvested foods. Following a hypothetical failure of Runit Dome, radiological doses to lagoon biota were estimated to be approximately 500–1,000 times lower than action levels recommended by DOE, the International Atomic Energy Agency, and United Nations Scientific Committee on the Effects of Atomic Radiation.

## IV. Conclusion

The results of the PNNL study, combined with data from ongoing DOE environmental monitoring programs, indicate no potential for increased health risks to residents of inhabited islands in the Enewetak Atoll from current or future conditions considering the impacts of climate change, including a hypothetical failure of Runit Dome. Estimated changes in radiological dose for all postulated scenarios to aquatic biota in the lagoon are not anticipated to impact the health and diversity of the environment of Enewetak Atoll.

In addition, the results indicate that the Runit Dome does not represent a significant source of radiation exposure relative to other sources of residual radioactive contamination and naturally occurring radiological sources within the Enewetak Atoll.

## V. Appendix

The Pacific Northwest National Laboratory study, *Impacts of Climate Change on Human Health and the Environment in the Enewetak Atoll* is attached.