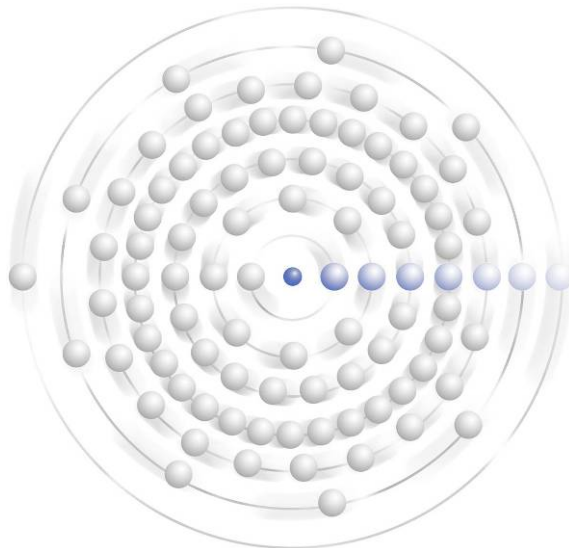




Japan's Nuclear Energy Program after Fukushima

Japan's Post-Fukushima Impacts on the Global Nuclear Reactor and Fuel Markets



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Introduction & Overview

Seven months have passed since the tragic earthquake and tsunami struck northeast Japan and caused the worst nuclear power accident in the country's history with three partial meltdowns at Tokyo Electric Power Company's (TEPCO) Fukushima Daiichi nuclear power plant. Although the accident response is still ongoing at the plant and thousands of people are still evacuated from the area around the site, the longer-term impacts of the accident on Japan's energy policies, electric power industry, and especially the nuclear industry are beginning to become clearer.

In order to begin the process of understanding what this accident means for Japan's nuclear energy program, The Ux Consulting Company (UxC) has prepared this special report. The primary goals of this report are to provide an overview of the most relevant developments that have occurred in Japan following the accidents at Fukushima Daiichi and to analyze the impact of the policy measures implemented by the Japanese government over the last seven months as well as the potential implications and viability of a nuclear power phase-out program, as recently announced by Prime Minister Yoshihiko Noda. In addition, this study analyzes the actual and potential impacts of Japan's post-Fukushima nuclear power policies on the country's nuclear fuel cycle program, and, as an extension, the impacts that these changes will likely have on the global nuclear fuel market.

Structure and Content of this Report

The contents of this special report have been extracted from two recent lengthy updates published as part of UxC's *Policy Watch* subscription service, although additional detailed information and updates are also provided here that have not been sent to our *Policy Watch* clients. Still, the structure of this report is such that it has two main chapters as detailed below.

- **Chapter 1: Japan's Nuclear Power Program**

The first chapter offers numerous background material and reviews the impacts of the Fukushima accident on Japan's nuclear power program and the near-term as well as long-term implications for the reliance on nuclear power generation in the country.

Before March 11, 2011, Japan had 54 commercial reactors with 47.1 GWe (net) of nuclear power generating capacity, amounting to almost 30% of the country's total electricity production. The Japanese government intended to increase this figure to 50% of total power generation by 2030.

On March 11, 2011, a tsunami triggered by a massive earthquake with epicenter about 43 miles (70 km) from the northeast coast of Japan struck TEPCO's Fukushima Daiichi nuclear power plant. Over a period of one week after the tsunami, multiple emergency core cooling systems were lost and partial core meltdowns occurred at Units 1, 2, and 3; further damage occurred to Unit 4, where radioactivity from the spent fuel pool (SFP) became a major concern.

Since the Fukushima Daiichi accident, the government has been dealing with the immediate as well as long-term impacts. Stress tests are to be conducted on all of the country's operating reactors. A reform of the existing nuclear regulatory framework as well as a reformulation of the country's energy policy with a downgrading of the use of nuclear power have been announced. Several measures concerning the future of TEPCO and compensation of the victims of the accident are also underway.

The newly-elected Prime Minister Yoshihiko Noda, in one of his first speeches upon assuming office, defined both construction of new reactors and lifespan extension of existing units unrealistic, but also stated that some idle nuclear power plants will be restarted if safety checks have a positive outcome. He also added that new reactor projects currently under construction will be reviewed on a "case-by-case" basis.

After reviewing the accident and its effects on government policies and nuclear safety regulations in Japan, this chapter goes into an in-depth analysis of the future use of nuclear power and the potential for a full or partial phase-out of reactors in the future.

• Chapter 2: Japan's Nuclear Fuel Cycle Program

Based on our review and analysis of the nuclear power program after Fukushima, the second main chapter of this report focuses on the status and prospects for all aspects of Japan's nuclear fuel cycle program, including both domestic front-end and back-end activities as well as nuclear fuel imports. Relevant background is also provided.

In terms of front-end nuclear fuel cycle activities, most of Japan's efforts have gone into improving nuclear fuel supply security through foreign investments, partnerships, and contracting with international producers. However, the country also has some important domestic fuel cycle activities, such as its own enrichment facility at Rokkasho along with four separate fuel fabrication plants.

On the back-end of the fuel cycle, in order to enhance energy security, Japan has long been engaged in developing a closed nuclear fuel cycle program through the reprocessing of domestic spent nuclear fuel (SNF) and recycling of separated plutonium as mixed oxide (MOX) fuel in light water reactors (LWR). While early reprocessing occurred in France and the UK, Japan is now in the late stages of deploying its own large reprocessing plant at Rokkasho. Japan's radioactive waste management structure is also well established, although disposal of high-level waste (HLW) is far from a done deal.

As Japan's nuclear fuel cycle program and role in the global nuclear fuel markets is quite extensive, the near- and long-term effects of Fukushima on the fuel cycle are expected to be significant. This second chapter analyzes all aspects of the Japanese nuclear fuel cycle after Fukushima, with special emphasis on examining how the changes in both domestic and international nuclear fuel cycle activities (including nuclear fuel procurement) will impact the global nuclear fuel markets. Specifically, this included detailed analysis of Japan's nuclear fuel inventories and the potential for excess inventories to enter the global fuel markets as a result of reduced consumption.

UxC's Japan Expertise and Analysis after Fukushima

This special report on Japan and many other publications that UxC has issued since March 11 incorporate the deep knowledge of the Japanese nuclear program as found in UxC's experienced team of experts. This report relies especially on the expertise of Jonathan Hinze, Vice President, International Operations, who has been supported by a capable team of UxC research and analytical staff. Jonathan worked for over five years directly in the Japanese nuclear industry prior to joining UxC in 2006. During his time working for the Federation of Electric Power Companies (FEPC) as well as a consultant to many Japanese clients, including government agencies (METI, NISA, JNES) and leading companies (utilities, NSSS vendors, fuel suppliers), Jonathan gained countless insights into the entire Japanese nuclear energy program. Given his Japanese language capabilities, Jonathan was also part of a team of U.S. experts supporting TEPCO in a major project to improve safety culture and nuclear team communications. This project led him to spend three months on the ground at TEPCO's headquarters and the Fukushima Daiichi and Daini nuclear power plants. This report therefore benefits from Jonathan's unique perspectives on Japan.

In addition to this report on Japan, UxC also issued a 350+ page special report in June 2011 entitled *Nuclear Power in the Post-Fukushima Era*, which was subsequently updated with a 180 page addendum published in September. This comprehensive report covers a wide range of topics, including full-scope Fukushima accident recap and technical analysis, lessons learned from the accident, implications for new and operating reactors around the world, as well as other technical and commercial implications. The thrust of this study is to show that although nuclear power has been damaged by the Fukushima accident, lessons learned can translate into technological improvements resulting in lower risks, and, therefore, it is not impossible to restore nuclear power's reputation. As presented throughout UxC's Post-Fukushima special report, there are many ways in which nuclear power can recover and become even more sustainable if the lessons of the Fukushima accident are converted into rapidly implemented technological, regulatory, and procedural improvements.

Moreover, additional research and analysis of the Fukushima accident have also been and will continue to be reported in other standard UxC publications. As noted, the contents of this report borrow heavily from two recent updates issued as part of UxC's *Policy Watch* subscriber service, which is a valuable tool for clients wishing to stay abreast of all the major developments in the nuclear power and fuel cycle policy world, especially as these policies impact the industry and markets. UxC's *Nuclear Power Outlook* (NPO) quarterly reporting service offers updated research and analysis of all nuclear power programs and reactor developments by country around the world, including detailed nuclear power forecasts through 2030. UxC's Market Outlook reports cover each of the nuclear fuel markets (uranium, conversion, enrichment, and fabrication), and recent editions of these have all included essays on the Fukushima impacts on each individual market. Finally, subscribers to our industry-leading *UxWeekly* newsletter will also be aware of the many cover stories and news briefs that have reported and analyzed the global nuclear industry effects from Fukushima.