FORATOM
THE VOICE OF THE EUROPEAN NUCLEAR INDUSTRY

Factsheet

How does Fukushima differ from Chernobyl?

Category	Fukushima Daiichi accident	Chernobyl accident
Date of accident	11 March 2011	26 April 1986
Main cause	Natural disaster and insufficient protections	Human error and design flaws
Accident details	A magnitude 9.0 earthquake and two resulting tsunamis (10 to 15 meters high) damaged the plant's power systems, which were located at a very low elevation, and the ultimate heat sink, causing cooling systems to fail. A series of gas explosions followed and the spent fuel pools ran low of water, but were not damaged.	Unconventional reactor operations at Chernobyl resulted in a runaway power surge followed by steam and hydrogen explosions and a sustained fire in the reactor. The accident was due to six critical human errors including the shut off of automatic controls and of the emergency safety cooling system and to a lack of safety culture. The explosions propelled radioactive material from the reactor core high into the atmosphere and across eastern and western Europe for at least 10 days.*
INES rating	Level 7 - major accident	Level 7 - major accident
Number of reactors	Six; but only three affected	Four; but only one reactor affected
Type of reactors	Boiling-water reactors (BWR-3 and -4). Unlike Chernobyl, the Fukushima plant has containment structures that prevented dispersal of most of the radioactivity. Also, the reactors at Fukushima do not have a combustible graphite core.	Soviet graphite-moderated reactor (RBMK). The graphite made it highly combustible. The reactor also had no robust containment structures and nothing stopped the trajectory of radioactive materials into the air.
Radiation released	About 10% of the corresponding equivalent of Chernobyl & 5% of total area contaminated by Chernobyl according to the French IRSN (Institute of Radioprotection and Nuclear Safety) report published in March 2012	12 million terabecquerels*****
Emergency response	The Japanese authorities took early steps to evacuate people, distribute potassium iodide, and restrict the transport and sale of food from the region.*	The Soviet authorities failed to take immediate action to protect surrounding populations: no early and wide spread use of protection measures such as the distribution of potassium iodine and the control of food supply in affected areas.*
	20km; 20-30km voluntary zone and five communities located beyond the evacuation zone	30km

Evacuation zone	(evacuation order lifted in some areas)**	
People evacuated	150,000***	The authorities evacuated, in 1986, about 116,000 people from areas surrounding the reactor and subsequently relocated, after 1986, about 220,000 people from Belarus, the Russian Federation and Ukraine.*****
Related deaths	No radiation-related deaths or acute diseases have been observed among the workers and general public exposed to radiation from the accident.***	The total deaths reliably attributable to the radiation produced by the accident stands at 62. *****
Long-term health damage	The doses to the general public, both those incurred during the first year and estimated for their lifetimes, are generally low or very low. No discernible increased incidence of radiation-related health effects are expected among exposed members of the public or their descendants. The most important health effect is on mental and social well-being, related to the enormous impact of the earthquake, tsunami and nuclear accident, and the fear and stigma related to the perceived risk of exposure to ionizing radiation. ***	Among the residents of Belarus, the Russian Federation and Ukraine, there had been up to the year 2008 more than 6,000 cases of thyroid cancer reported in children and adolescents who were exposed at the time of the accident.(by 2005, 15 cases had proved fatal).****
Current status	The state of the reactors is stable. The removal of all of the fuel assemblies stored in the reactor unit 4 spent fuel pool (SFP) was completed in 2014. Measures are being implemented at reactor units 3 to reduce radiation dose level and the building of unit 2 reactor is being dismantled in preparation for fuel removal. The cover installed on reactor unit 1 in 2011 was temporarily removed in 2015 to prepare for the removal of fuel and rubbles from the reactor building and the SFP. Radiation released into the atmosphere from units 1 to 3 has decreased drastically and in July 2013 was only 1/80 millionth what it was just after the accident. Measures to prevent leakage of contaminated water are also being taken including the pumping of groundwater and the installation of an ice wall and of sea-side impermeable walls. Water pumped from the plant is also being decontaminated. *****	The damaged reactor is now encased in a concrete shell. A New Safe Confinement (NSC) structure is due to be completed in 2017. Nuclear waste repositories are currently being built in the exclusion zone of Chernobyl.
Post-accident safety improvements	The EU decided just after the accident to introduce on a voluntary basis safety assessments (“stress tests”) in order to reassess the safety of operating nuclear plants Europe-wide in the light of the Fukushima accident. European nuclear operators carried out safety evaluations at each nuclear power plant and national safety authorities produced reports	Modifications have been made to overcome deficiencies in all the RBMK reactors still operating. All of the RBMK reactors have now been modified by changes in the control rods, making them very much more stable at low power. Automatic shut-down mechanisms now operate faster, and other safety mechanisms have been improved. Automated inspection equipment has also been installed. Since 1989, over 1000 nuclear engineers from the former

	based on those evaluations that went through a peer review process. Not a single nuclear power plant in Europe was recommended for closure as a result of this process, which testified to the high overall level of safety at Europe's nuclear installations. National regulators published national action plans (NAcP) for operators to implement the safety recommendations including the addition of equipment to compensate for the potential loss of all electrical power and the potential loss of the ultimate heat sink for cooling, the installation or improvement of on-site seismic instruments and the availability of a backup emergency control room. "Stress tests" were also made outside of Europe in the US, Japan and in neighbouring countries: Armenia, Belarus, Croatia, Russia, Switzerland, Turkey and Ukraine.	Soviet Union have visited Western nuclear power plants and there have been many reciprocal visits.******
Current nuclear policy	Japan's new energy strategy adopted in 2014 aims at increasing the share of nuclear in total electricity production to 20% by 2030. Four nuclear reactors have already resumed operation. There are currently 39 other commercial reactors that potentially illegible for restart provided the nuclear safety regulator gives its greenlight.*******	Ukraine has 15 reactors in operation and 2 under construction. Nuclear power accounted for almost 50% of the country's total electricity production in 2014. The government plans to maintain nuclear share in electricity production to 2030, which will involve substantial new build.*******

*Source: Nuclear Energy Industry (NEI)

**Source: METI, September 2015

***Source: United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), Levels and effects of radiation exposure due to the nuclear accident after the 2011 great east-Japan earthquake and tsunami, 2014

****Source: United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2008 report, *Health effects due to radiation from the Chernobyl accident*

*****Source:* TEPCO, JAIF, May 2015 & Citizens Nuclear Information Center, February 2016

******Source: World Association of Nuclear Operators (WANO)

*******Source: World Nuclear Association (WNA) & PRIS IAEA

Annexes:

I Chernobyl RBMK design and Fukushima- Daiichi BWR Mark I design

II Current status of Fukushima Daiichi reactors & evacuation zone

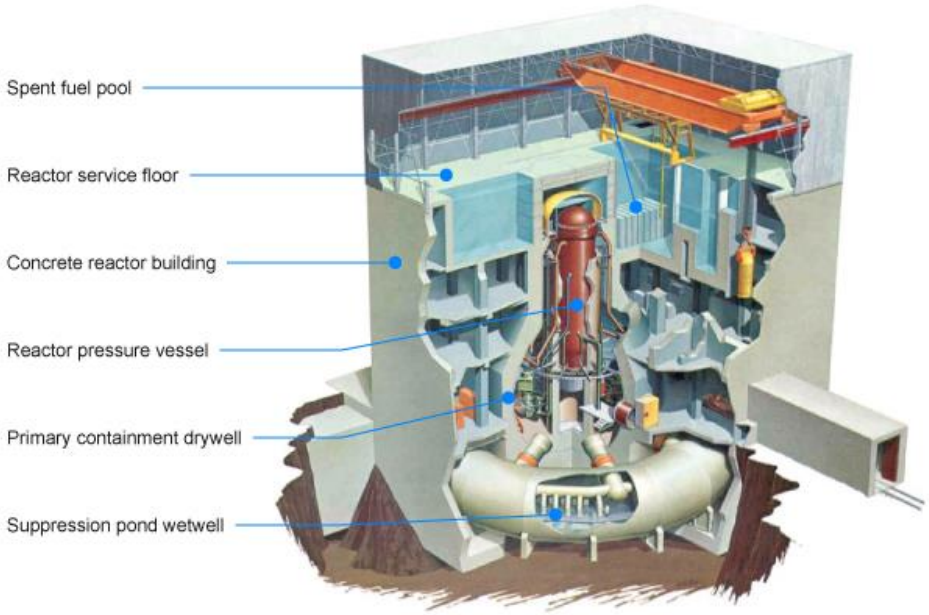
III Nuclear reactors in the world

Annex I

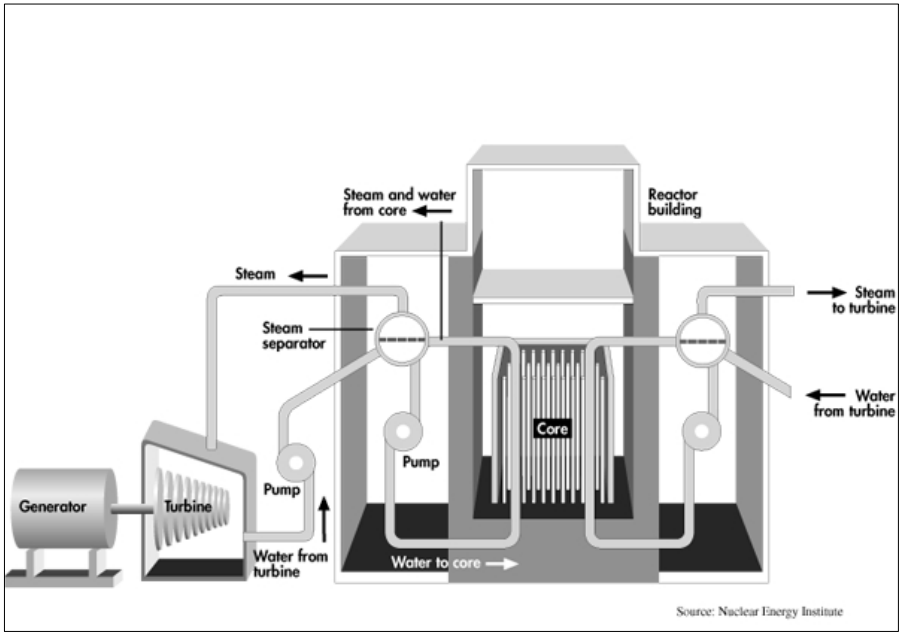
Chernobyl RBMK design and Fukushima Daiichi BWR Mark I design

Contrary to the Fukushima Daiichi plant, RBMK reactors at Chernobyl had no robust containment structures and had a highly combustible graphite core.

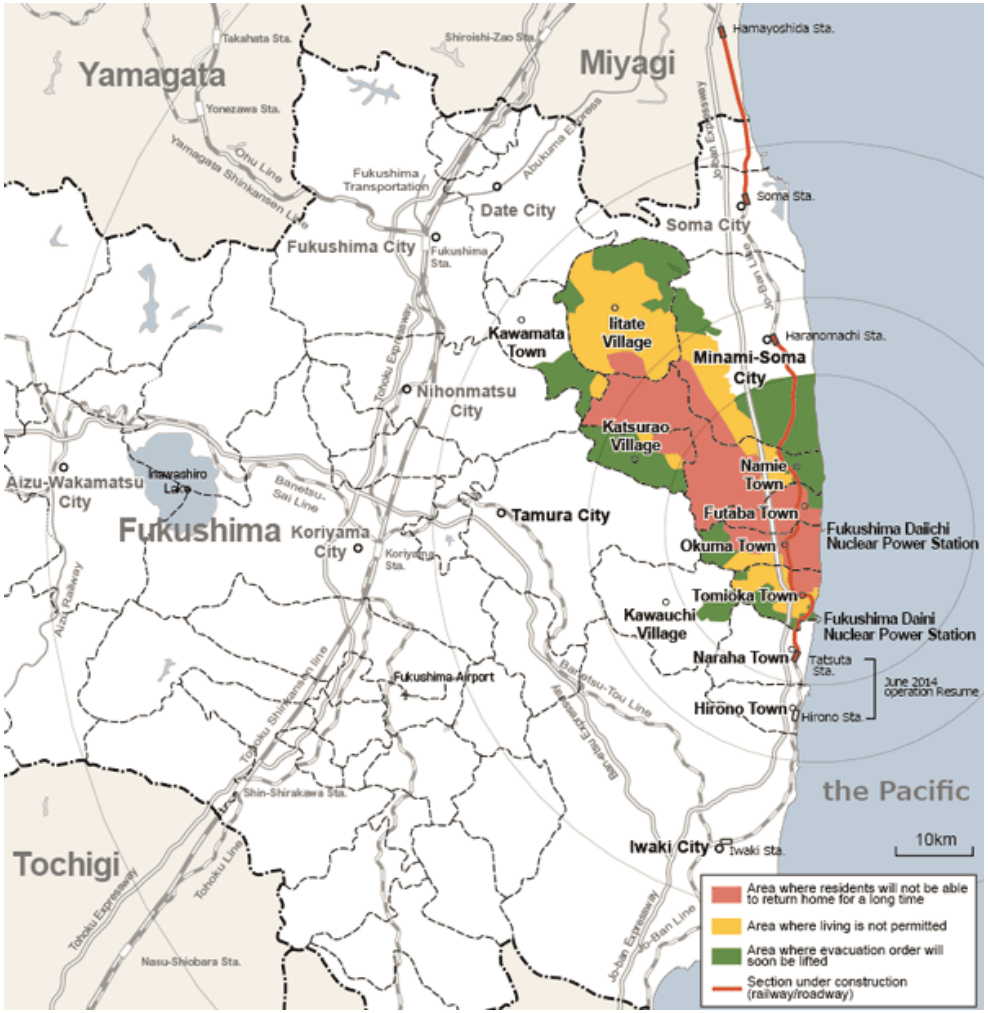
1. BWR Mark I design



2. RBMK design



Annex II
Fukushima Daiichi evacuation zone

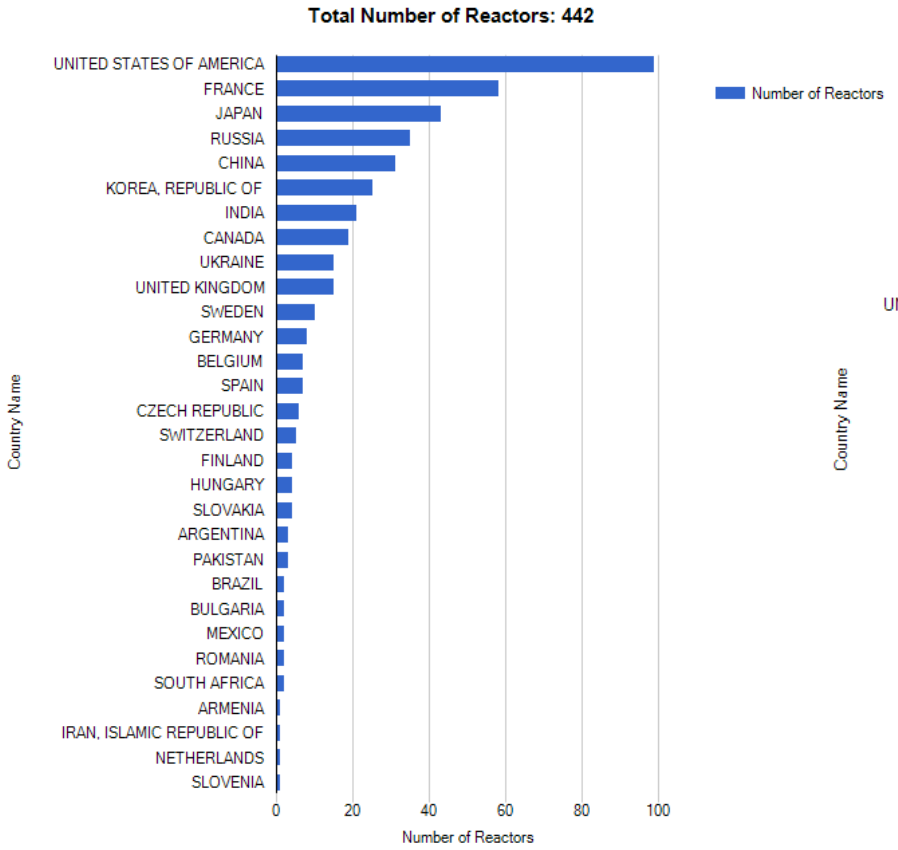


Source: JAIF

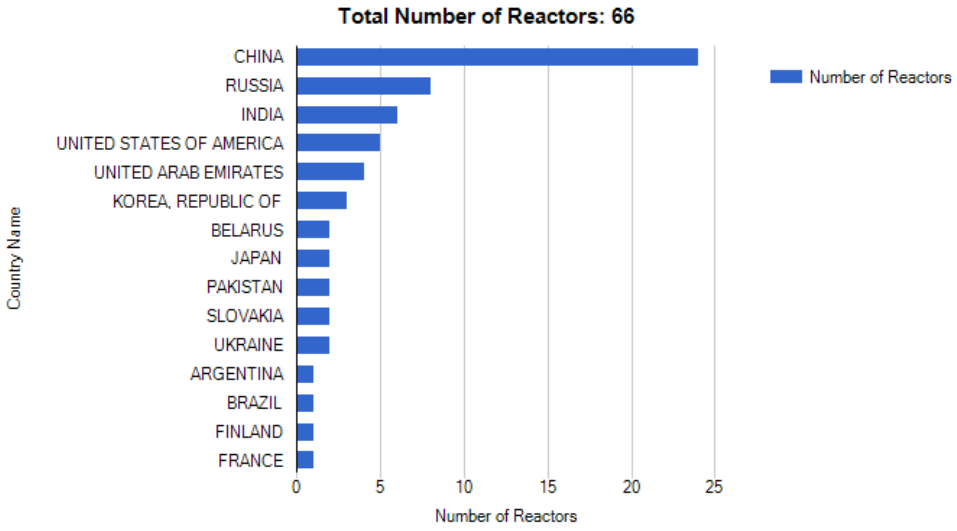
Annex III

Nuclear reactors in the world

1. In operation



2. Under construction



Source: [PRIS, IAEA]