

World's Nuclear Generating Capacity Down about 1,800MW, Waits to Grow

JAIF Annual Report "World Nuclear Power Plants 2009"

The Japan Atomic Industrial Forum, Inc. (JAIF) issued a report titled "World Nuclear Power Plant 2009" on April 17, surveying the worldwide nuclear power developments in 2008. The report confirms that a total of 432 nuclear power plants (NPPs) were in operation worldwide in 2008, generating about 390,444 MW of electricity, with no new plants commencing commercial operation.

Overview of the report

The report points out that is particularly noteworthy that Sweden and Italy, both of which had suspended nuclear power generation efforts, have returned fully to the promotion of nuclear usage. In the United States and Britain, as well, preparatory procedures for new NPPs moved forward steadily. India and China are hastening to add substantially to their capacities to cope with rapid increases in electricity demand resulting from those countries' economic growth: India plans to increase its nuclear capacity from the existing 4,000MW to 6,300MW by 2032, and China, from 9,000MW now to 70,000MW by 2020.

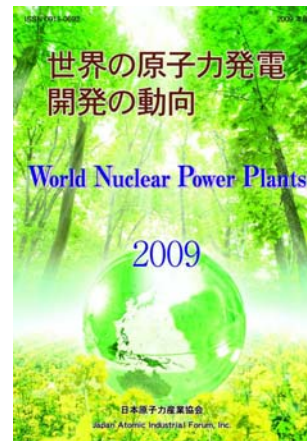
While no new NPPs entered service anywhere in the world in 2008, three units (total 1,820MW) were closed in Slovakia and Japan (Japanese data as of March 31, 2009), reducing total global operating capacity by 1,797MW from the previous survey. There were some 20MW of upgrades at individual units.

As you can find in attached "Major Movements in 2008", construction was launched on nine new NPPs in four countries (Japan, the United States, Slovakia and China), of which three (one in the United States and two in Slovakia) were examples of construction having resumed after being on hold for many years.

In Japan, construction work began on the Ohma Nuclear Power Station (NPS), about two years

behind the original schedule. In China, construction commenced at five new NPPs, including the new Fuqing and Ningde sites.

In 2008, 16 NPPs (18,912MW) were added to nuclear development programs in three countries. Significantly, eight of the 16, located at four sites in the United States, mark the first orders placed in that country in more than 30 years. Utility companies there have already concluded engineering-procurement-construction (EPC) contracts with manufacturers. In Japan, plans to construct the Sendai-3 NPS and the Hamaoka-6 NPS were included in the nation's Electric Power Supply Plan as of the end of the fiscal year (i.e., March 31, 2009). China also forged ahead with its nuclear development program: in addition to the Fuqing and Ningde NPPs, a plan emerged to build the Fangjiashan NPS in an expansion of the Qinshan-I site.



Since 1966, JAIF has published its annual "World Nuclear Power Plants" based on response to its questionnaires and other information from nuclear utilities and so forth.

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In the period covered by the survey, three units were closed – one in Slovakia and the Hamaoka-1 and -2 NPSs in Japan – as mentioned above.

Outline related to Japan

Work Progresses to Restore Kashiwazaki-Kariwa NPS

Inspections and restoration work have proceeded steadily at the existing reactors of the Kashiwazaki-Kariwa NPS, suspended after the Niigata Chuetsu Offshore Earthquake in July 2007.

In May 2008, Tokyo Electric Power Co. (TEPCO) submitted a report to the Nuclear and Industrial Safety Agency (NISA) on data recorded at the site during the earthquake, and the issuance of a new standard ground acceleration. According to the report, maximum acceleration under the new standard is to be 2,280 Gal, about five times the 450 Gal that was the standard ground acceleration (S2) based on Japan's previous Examination Guide for Aseismic Design of Nuclear Power Reactor Facilities. TEPCO decided to implement seismic retrofitting to withstand 1,000 Gals at all Kashiwazaki-Kariwa units.

In 2009, TEPCO filed with NISA a report on a new seismic safety back-check on Unit 7 at Kashiwazaki-Kariwa, and at the end of January the government approved the final report proposed by NISA, concluding that the determination of "ensured seismic safety" at Unit 7 was appropriate. Upon confirmation that all systems at Unit 7 function equivalently to before the earthquake, which was obtained through systems tests completed by early February, Niigata Prefecture required that TEPCO obtain preliminary consent from local communities before it conducts functional tests of the entire plant, which will involve restarting the reactor. Meanwhile, Kashiwazaki City lifted an order that had prohibited operation of Unit 7 under the Fire Service Law. Now, TEPCO is in the final stages of preparation for the whole-plant functional tests. After Unit 7, inspections and restoration work will be carried out one by one at Unit 6 and Units 1 through 3.

Construction of Ohma NPS Launched: World's First Full-MOX ABWR

In May, the Electric Power Development Co. (J-Power) received approval from the Ministry of Economy, Trade and Industry (METI) to install a reactor at the Ohma NPS (full-MOX fuel, ABWR, 1,383 MW) in Aomori Prefecture. J-Power began construction of the Ohma NPS 32 years after the Ohma association of commerce and industry, in 1976, asked the town assembly to conduct an environmental survey.

In March 2004, J-Power filed an application with METI for permission to install the world's first full-MOX light water reactor.

J-Power plans to load fuel into the unit in December 2013 and start commercial operation in November 2014, systematically phasing up utilization of MOX fuel from one-third of the reactor core to MOX fuel for the entire core.

On the assumption that MOX fuel equivalent to one-third the reactor core will be loaded at each refueling, the amount of plutonium to be used annually is expected to be about 1.1 tons.

MOX-Fuel-Use Program Being Implemented at Utilities One After Another

The Federation of Electric Power Companies (FEPC) intends to burn MOX fuel at a total of 16-18 units by 2010. In 2008, each utility made efforts and saw progress in its program.

In April 2008, Hokkaido Electric Power Co. proposed to Hokkaido Prefecture and four local towns and villages the start of discussions toward obtaining prior understanding from the local parties, under the terms of its existing safety agreement with them. The Tomari-3 NPS is preparing for commercial operation at the end of this year, after reaching first criticality on March 3, 2009.

On March 5, 2009, the municipalities conveyed to the utility their agreement to the request for preliminary consent.

Chubu Electric Power Co. steadily advanced its MOX-use Program. After announcing its plan to use MOX fuel in September 2005, the utility filed an Application for Permission to Change a Reactor Installation for its Hamaoka-4 NPS in

March 2006, and received approval in July 2007. In February 2008, local municipalities and Shizuoka Prefecture announced their agreement to implementing the MOX-use Program at Hamaoka-4. In May 2008, the utility commenced fabrication of MOX fuel at the Melox Plant in France, and, on March 6, 2009, a vessel transporting 28 MOX fuel assemblies left Cherbourg, France.

The Kansai Electric Power Co. had planned to implement the MOX-use Program at its Takakama-3 and -4 NPSs, but voluntarily suspended the effort in the wake of the falsification of data on MOX fuel produced by British Nuclear Fuels (BNFL) and the rupturing of pipes in 2004 in the secondary piping system at its Mihama-3 NPS. After Fukui Prefecture announced understanding of resumption of the program in January 2008, the utility decided to resume preparatory work, officially concluding contacts with Nuclear Fuel Industries Ltd. and the French Melox Plant on procurement of 16 MOX-fuel assemblies to be used at the Takahama-3 and -4 NPSs. It plans to commence MOX-fuel usage at those units in FY2010.

In September 2005, Chugoku Electric Power Co. submitted a request for consent on the MOX-use Program at its Shimane-2 NPS to Shimane Prefecture and Matsue City. The utility filed an Application for Permission to Change a Reactor Installation for Shimane-2 in October 2006, which was approved in October 2008. The utility will load up to 228 MOX-fuel assemblies (out of the total 560 assemblies) by 2010.

In order to begin using MOX fuel at its Ikata-3 NPS by 2010, Shikoku Electric Power Co. submitted requests for preliminary consents to Ehime Prefecture and Ikata Town in 2004. After receiving agreement from the prefecture and the town in November 2004, it submitted an application to the government in March 2006. In November 2006, the utility concluded an agreement with Mitsubishi Heavy Industries (MHI) for fabrication of MOX fuel (MHI had entered into a fuel production agreement with the Melox Plant). Production of 21 MOX-fuel assemblies commenced in April 2008.

Deciding in 2004 to use MOX fuel at its Genkai-3 NPS, Kyushu Electric Power Co. made requests for preliminary consents to Saga

Prefecture and Genkai Town in May 2004, and filed an Application for Permission to Change a Reactor Installation with the government, which was approved in 2005. Production of MOX fuel ordered from the Melox Plant commenced in 2007, and an application was filed within 2008 with METI for inspection of the imported fuel. MOX-fuel assemblies completed in January 2009 were shipped in March from the Cherbourg port in France, together with ones for the Chubu Electric and Shikoku Electric.

Completion of Rokkasho Reprocessing Plant Slides Within 2009

As of the end of 2008, total plutonium held by Japan was 27.4 tons – 2.2 tons in Japan and 25.2 tons in England and France. The Rokkasho Reprocessing Plant, owned by Japan Nuclear Fuel Ltd. (JNFL), which will be completed in August 2009, has received 12,374 spent fuel assemblies (about 2,926 tons) over the period from April 2008 through the end of November. In FY2009, the plant will reprocess 160 tons of spent fuel and recover 0.9 tons of plutonium. The Federation of Electric Power Companies (FEPC) expects the amount of plutonium held by Japan to increase to about 3.2 tons by the end of FY2009, which will be fabricated at the Rokkasho MOX Fuel Plant, whose operation is to start in FY2012, and be used at domestic nuclear reactors as MOX fuel. As of 2008, JNFL planned to complete the reprocessing plant in February 2009, but postponed that to August 2009 due to problems during active tests.

Monju Will Not Return to Criticality Until Late 2009

At the prototype fast breeder reactor “Monju” owned by the Japan Atomic Energy Agency (JAEA), modification work after a long-term suspension was completed in May 2007, and modified system function tests ended in August, confirming functioning and performance of the modified equipment and facilities. Entire-system function tests have begun to confirm the soundness of the entire plant. At the end of March 2008, however, one of the sodium leakage detectors at the primary system B loop was erroneously activated and JAEA decided to inspect all 611 detectors. The inspection work became prolonged, pushing back completion of the entire-system function tests two months,

until October 2008. Accordingly, the beginning of system start-up tests, which will involve criticality, was pushed back to February 2009.

In September 2008, however, a corrosion hole was discovered in the outdoor exhaust duct of the reactor auxiliary building and JAEA announced in January 2009 that it was postponing start of the entire-system tests again, until late 2009. According to JAEA's plan, after completion of repair work as a short-term measure in May, the entire-system function test will be resumed and preparatory work for system start-up tests will be finished by August 2009.

Hamaoka-1 & -2 NPSs to be Decommissioned; Hamaoka-6 NPS to be Built

Chubu Electric Power decided in 2005 to set maximum acceleration at 1,000 Gals and voluntarily began work to improve seismic margins at the Hamaoka NPS site. By March 2008, improvement work on Units 3 through 5 had been completed. The utility also carried out seismic back-checks according to new guidelines issued by the government for new nuclear reactors.

As for Units 1 and 2, however, the utility concluded they were not economically efficient. Unit 1 (commercial operation since 1976) has been suspended for years, since a pipe rupture in the piping system of the residual heat removal system in 2001. Unit 2 (commercial operation in 1978) was also suspended partly because of safety reviews following a periodic inspection in 2004. Moreover, while the cost of improving seismic margins at Units 3 through 5 was JPY 1-10 billion per unit, it could be as much as JPY 300 billion for Units 1 and 2 together, and require ten years or more. At a board meeting in December 2008, the utility decided to decommission both units based on lack of economic efficiency. At the same time, the "Hamaoka NPS Replacement Plan" was officially adopted – building Hamaoka-6, the same type 1,400 MW ABWR as Unit 5. The utility also decided to build a spent fuel dry storage installation for all Hamaoka units, and its President Toshio Mita proposed the plan to the local Omaezaki City and to the governor of Shizuoka Prefecture.

The Hamaoka-1 and -2 NPSs were legally closed on January 30, 2009, in line with the replacement plan. The Hamaoka-6 NPS will be built on the east side of Unit 5. Construction will start in 2015, with commercial operation in about 2020. The spent-fuel storage facility is expected to contain 700 tU and be in operation from FY2016.

Japan's Next-Generation LWR

Pursuant to the "Plan to Make Japan a Nuclear Energy Powerhouse" issued by the Advisory Committee for Natural Resources and Energy's Electric Utility Industry Subcommittee in 2006, development of next-generation LWRs began in FY2008, taking into account increased demand for replacement domestic reactors expected to be seen around 2030. The project is classified as a "national project," with the involvement of the Ministry of Economy, Trade and Industry (METI), the Federation of Electric Power Companies (FEPC) and various plant manufacturers, to develop light water reactors (LWRs) (one PWR and one BWR) in the 1,700-1,800 MW class, of a global standard, by making the best use of highly innovative technology. To be at the heart of the development, the Nuclear Power Engineering Center was established within the Institute of Applied Energy (IAE) and seeks to realize six concepts in the design: (1) substantial reduction of spent fuel and the world's highest availability factor; (2) substantially shortened construction periods; (3) simultaneous improvements in availability factor and safety; (4) the world's highest levels of safety and economy at the same time; (5) plant life of 80 years and substantially reduced exposure doses during maintenance; and (6) a standardized plant regardless of siting conditions. The basic designs are expected to take eight years to complete, with the Japanese public and private sectors contributing a combined JPY 60 billion.

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Generating Capacity of Nuclear Power Plants in the World

As of January 1, 2009 (10MWe, Gross Output)

Country Region	In Operation		Under Construction		Planned		Total	
	Output	Units	Output	Units	Output	Units	Output	Units
1 U.S.A.	10,630.2	104	120.0	1	940.0	8	11,690.2	113
2 France	6,602.0	59	163.0	1			6,765.0	60
3 Japan*1	4,793.5	53	394.8	4	1,655.2	12	6,843.5	69
4 Russia	2,319.4	27	621.0	8	585.0	5	3,525.4	40
5 Germany	2,145.7	17					2,145.7	17
6 Korea	1,771.6	20	680.0	6	280.0	2	2,731.6	28
7 Ukraine	1,381.8	15	200.0	2			1,581.8	17
8 Canada	1,328.8	18					1,328.8	18
9 United Kingdom	1,195.2	19					1,195.2	19
10 Sweden	938.4	10					938.4	10
11 China	911.8	11	1,333.5	13	1,360.9	13	3,606.2	37
12 Spain	772.7	8					772.7	8
13 Belgium	611.7	7					611.7	7
14 Taiwan	516.4	6	270.0	2			786.4	8
15 India	412.0	17	316.0	6	680.0	8	1,408.0	31
16 Czech	388.0	6					388.0	6
17 Switzerland	337.2	5					337.2	5
18 Finland	280.0	4	170.0	1			450.0	5
19 Brazil	200.7	2			135.0	1	335.7	3
20 Bulgaria	200.0	2			200.0	2	400.0	4
21 Hungary	197.0	4					197.0	4
22 South Africa	189.0	2			11.0*2	2	200.0	4
23 Slovakia	182.7	4	88.0	2			270.7	6
24 Lithuania	150.0	1					150.0	1
25 Romania	141.0	2	211.8	3			352.8	5
26 Mexico	136.4	2					136.4	2
27 Argentina	100.5	2	74.5	1			175.0	3
28 Slovenia	72.7	1					72.7	1
29 Netherlands	51.0	1					51.0	1
30 Pakistan	46.2	2	32.5	1			78.7	3
31 Armenia	40.8	1					40.8	1
32 Iran			100.0	1	36.0	1	136.0	2
33 Indonesia					400.0	4	400.0	4
34 Egypt					187.2	2	187.2	2
35 Israel					66.4	1	66.4	1
36 Turkey					N/A	3	N/A	3
37 Kazakhstan					N/A	1	N/A	1
38 Vietnam					N/A	1	N/A	1
Total (previous year)	39,044.4 (39,224.1)	432 (435)	4,775.1 (3,877.2)	52 (43)	6,536.7 (4,960.1)	66 (53)	50,356.2 (48,061.4)	550 (531)

*1 Japanese figures dated 2009.3.31.

*2 The unknown output is not included.

Major Movements in 2008

Start of Commercial Operation

None

Start of Construction

Japan	Ohma	(ABWR, 1,383 MW)	May. 24
China	Fangjiashan-1	(PWR, 1,087 MW)	Dec. 26
China	Fuqing-1	(PWR, 1,087 MW)	Nov. 21
China	Ningde-1	(PWR, 1,087 MW)	Feb. 18
China	Ningde-2	(PWR, 1,087 MW)	Nov. 12
China	Yangjiang-1	(PWR, 1,087 MW)	Dec. 16
Slovakia	Mochovce-3(Restart of Construction)	(PWR, 440 MW)	Nov. 3
Slovakia	Mochovce-4(Restart of Construction)	(PWR, 440 MW)	Nov. 3
U.S.A	Watts Bar-2(Restart of Construction)	(PWR, 1,200 MW)	Jan.

4 countries; 9 units; 8,898 MW

Included in Plan

Japan	Hamaoka-6	(ABWR, 1,400 MW-class)
Japan	Sendai-3	(APWR, 1,590 MW)
China	Fangjiashan-2	(PWR, 1,087 MW)
China	Fuqing-2	(PWR, 1,087 MW)
China	Yangjiang-3	(PWR, 1,087 MW)
China	Yangjiang-4	(PWR, 1,087 MW)
China	Yangjiang-5	(PWR, 1,087 MW)
China	Yangjiang-6	(PWR, 1,087 MW)
U.S.A	Alvin W. Vogtle-3	(PWR, 1,100 MW)
U.S.A	Alvin W. Vogtle-4	(PWR, 1,100 MW)
U.S.A	Levy County-1	(PWR, 1,100 MW)
U.S.A	Levy County-2	(PWR, 1,100 MW)
U.S.A	South Texas Project-3	(ABWR, 1,400 MW)
U.S.A	South Texas Project-4	(ABWR, 1,400 MW)
U.S.A	Virgil C. Summer-2	(PWR, 1,100 MW)
U.S.A	Virgil C. Summer-3	(PWR, 1,100 MW)

3 countries; 16 units; 18,912 MW

Closed

Slovakia	Bohunice-2	(PWR, 440 MW)	Dec. 31
Japan	Hamaoka-1	(BWR, 540 MW)	Jan.30. 2009
Japan	Hamaoka-2	(BWR, 840 MW)	Jan.30. 2009

2 countries; 3units; 1,820 MW