Status of occupational exposure in Asian region

ISOE Asian Technical Centre

2009 ISOE International ALARA Symposium
13-15 October 2009, IAEA HQ, Vienna, Austria

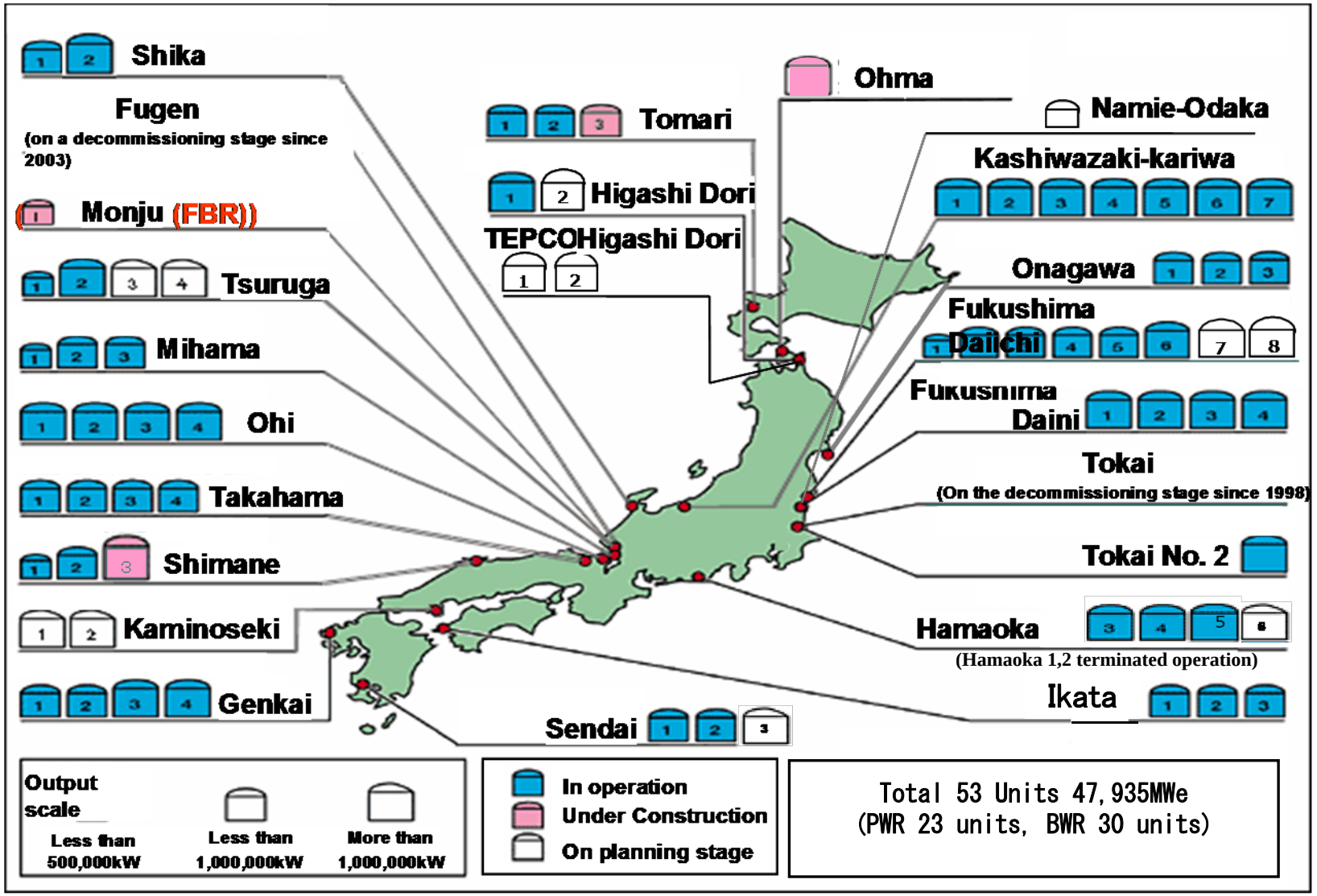
Contents

1. Status of Nuclear Power Plants in Japan

as of March 31, 2009

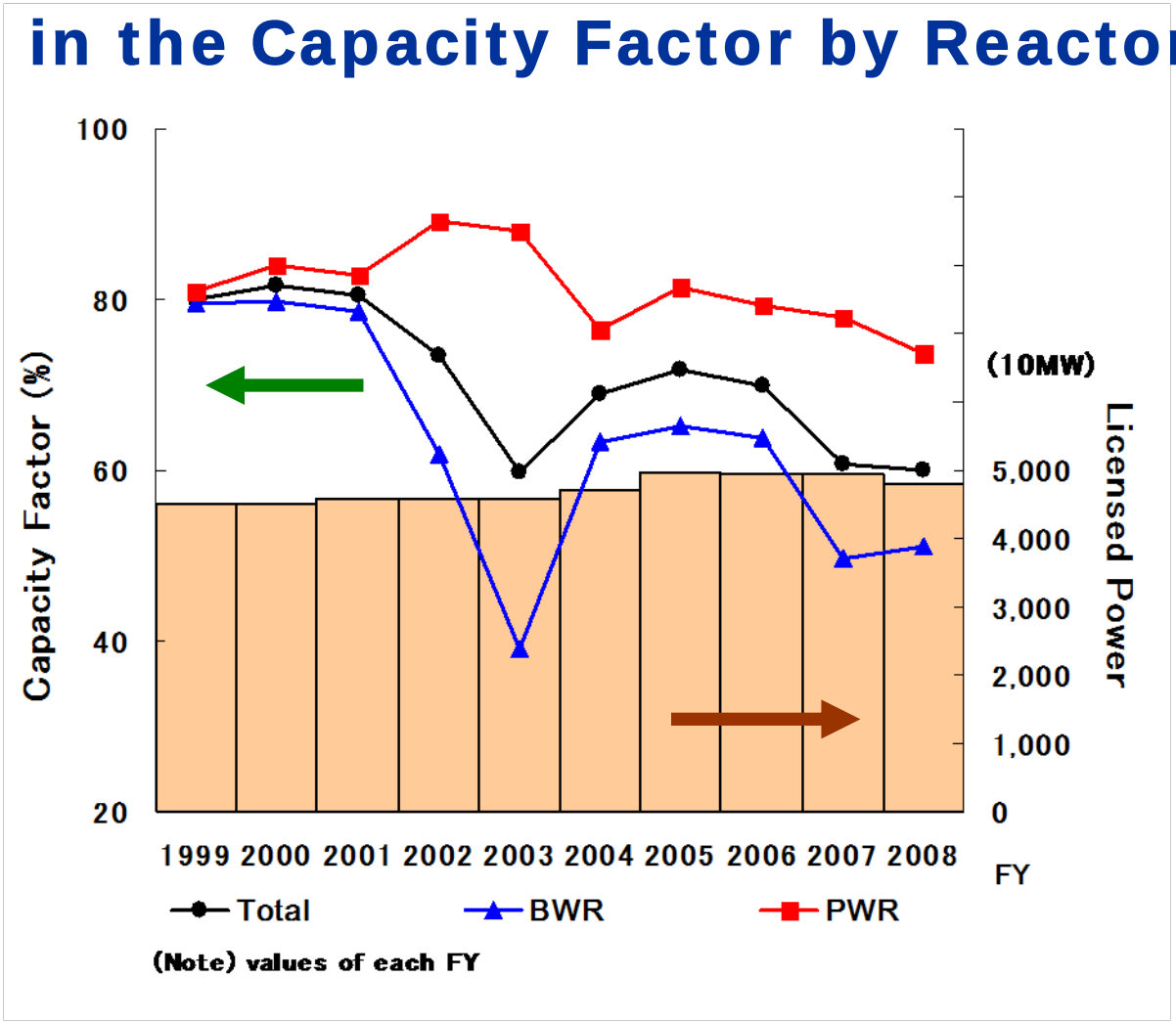
		BWR	PWR	GCR	Total
In Operation	No. of Units	30	23	-	53
	Output (MWe)	28,569	19,366	-	47,935
Under Construction	No. of Units	2	1	-	3
	Output (MWe)	2,756	912	-	3,668
On Planning	No. of Units	9	3	-	12
	Output (MWe)	11,886	4,666	-	16,552
Preparing Decommissioning	No. of Units	2	-	-	2
	Output (MWe)	1380	-	-	1380
Under Decommissioning	No. of Units	-	-	1	1
	Output (MWe)	-	-	166	166

1. Status of Nuclear Power Plants in Japan



1. Status of Nuclear Power Plants in Japan

Trend in the Capacity Factor by Reactor Type



2. Overview of Exposure of NPP in Asia

Individual Dose in Fiscal Year 2008 (April 2008 – March 2009)

Japan

Average annual dose - Total of radiation workers (79,684) - Total exposure (84.04 person-Sv)	1.1 mSv
Highest annual dose	19.5 mSv
Number of worker: > 20mSv	0
Number of worker: 15-20mSv	254 (0.3%)

2. Overview of Exposure of NPP in Asia

Collective Dose in Fiscal Year 2008 (April 2008 – March 2009)

Japan

Plants	Units	Persons-Sv	Person-Sv /unit
BWR	32	46.29	1.45
PWR*	24	37.73	1.57
GCR**	1	0.02	0.02
Total	56	84.02 (LWR)	1.53 (LWR)

(*) Include reactor under test operation

(**) Under decommissioning

2. Overview of Exposure of NPP in Asia

Individual Dose in 2008

Korea

Average annual dose	**0.94 mSv**
Highest annual dose	**33.6 mSv**

2. Overview of Exposure of NPP in Asia

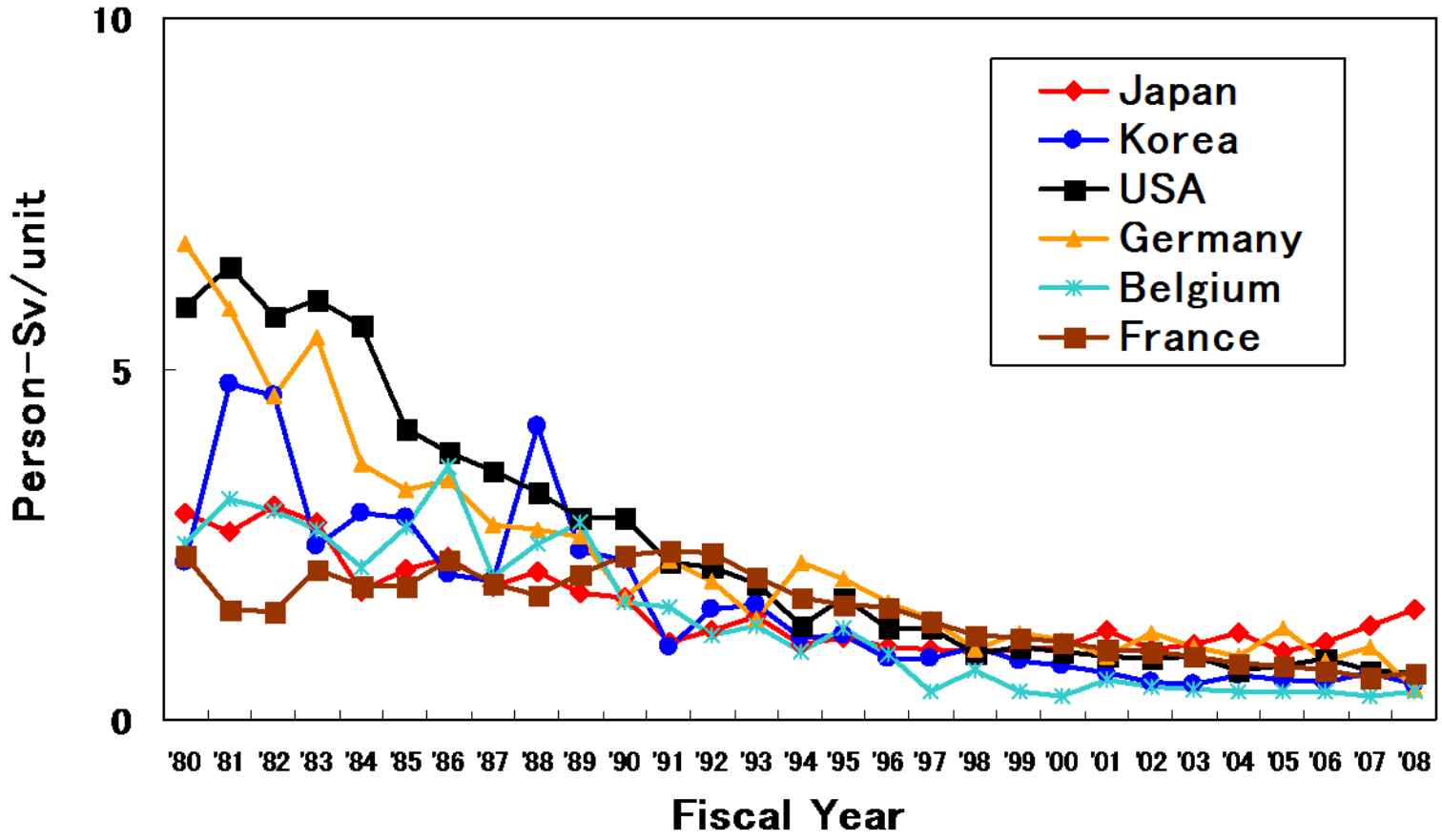
Collective Dose in 2008

Korea

Plants	Units	Person-Sv /unit
PWR	16	0.49
CANDU	4	0.59
Total	20	0.51

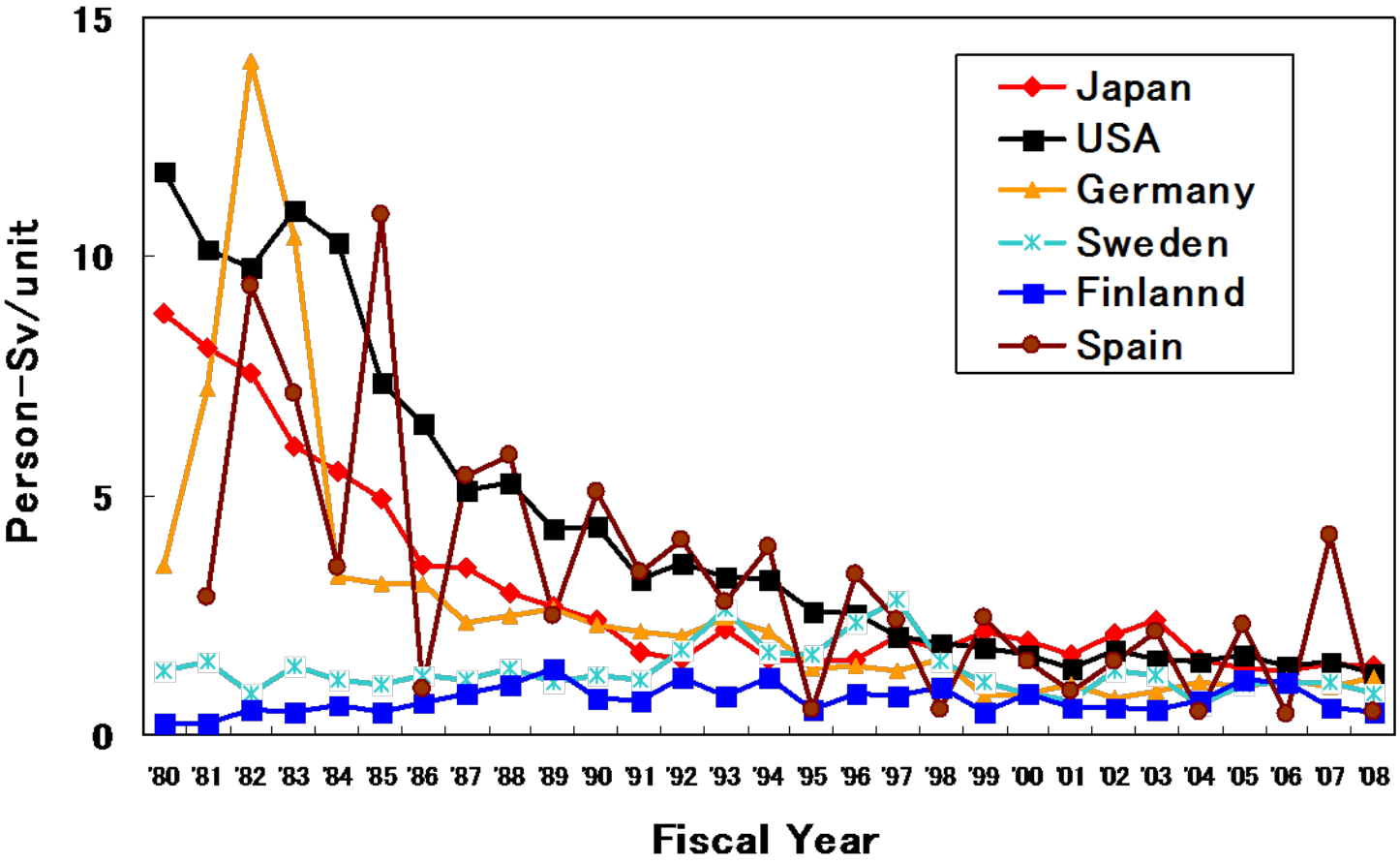
2. Overview of Exposure of NPP in Asia

PWR Average Collective Dose per Reactor by Country



2. Overview of Exposure of NPP in Asia

BWR Average Collective Dose per Reactor by Country



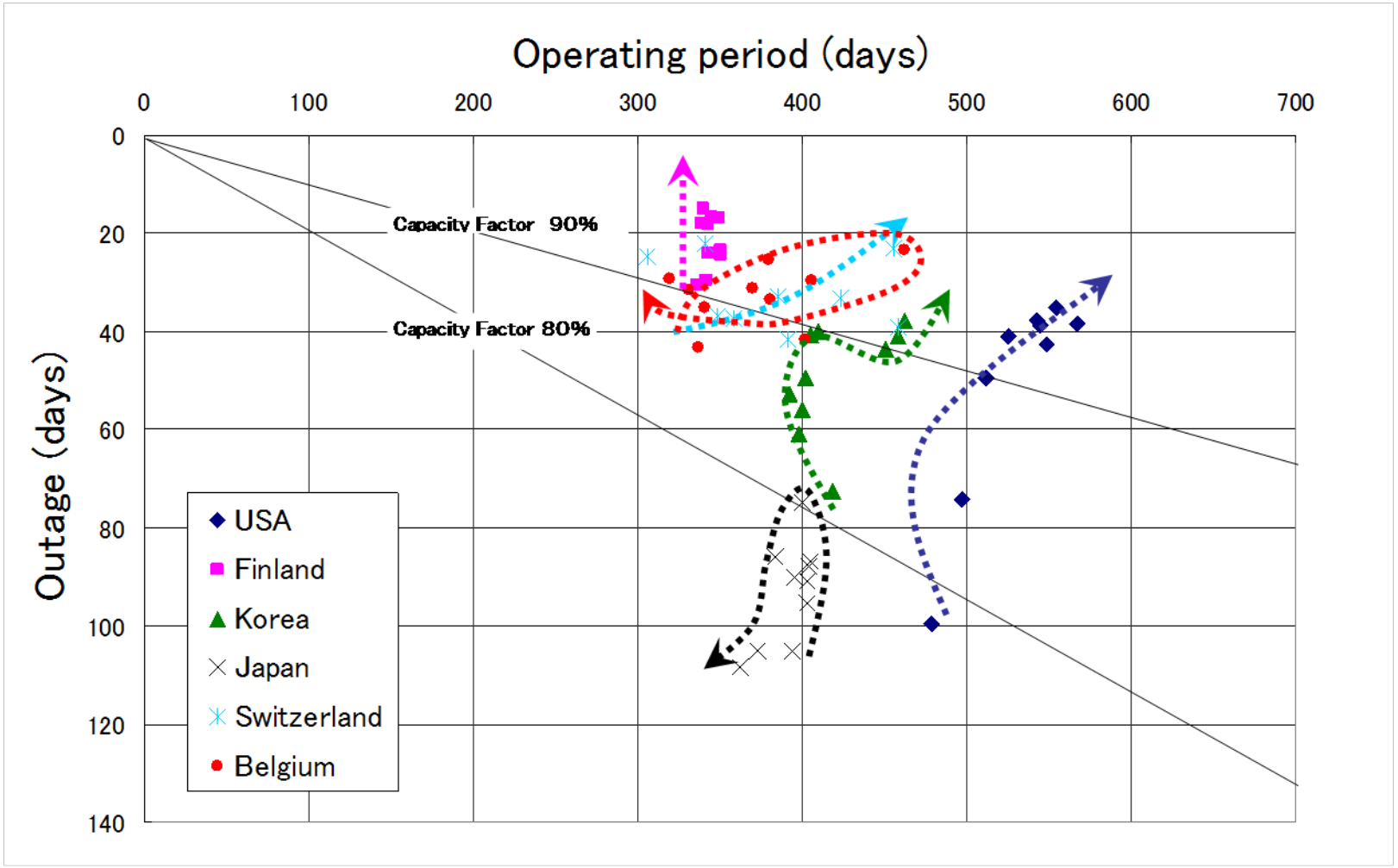
3. Exposure of NPP in Japan

- **Periodical inspections were completed at 11 BWRs and 21 PWRs.**
- **The average duration of outage for periodical inspection**
  138 days for BWRs and
  144 days for PWRs
- **Main works influencing exposure**

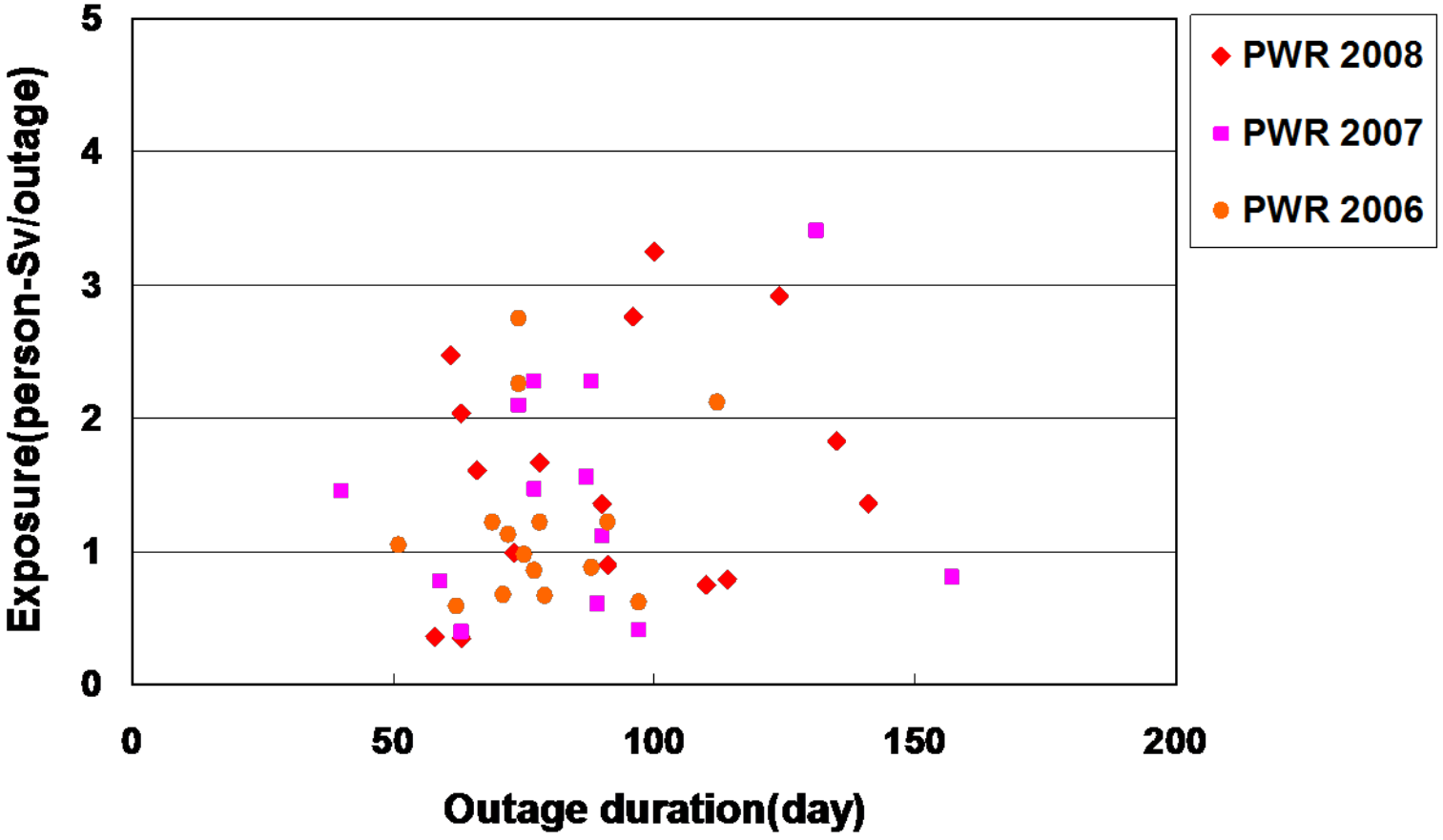
  - Repair works of the steam generator Nozzle Stubs in PWR

  - The works for improvement of the seismic safety margin and replacement of strainer in BWR

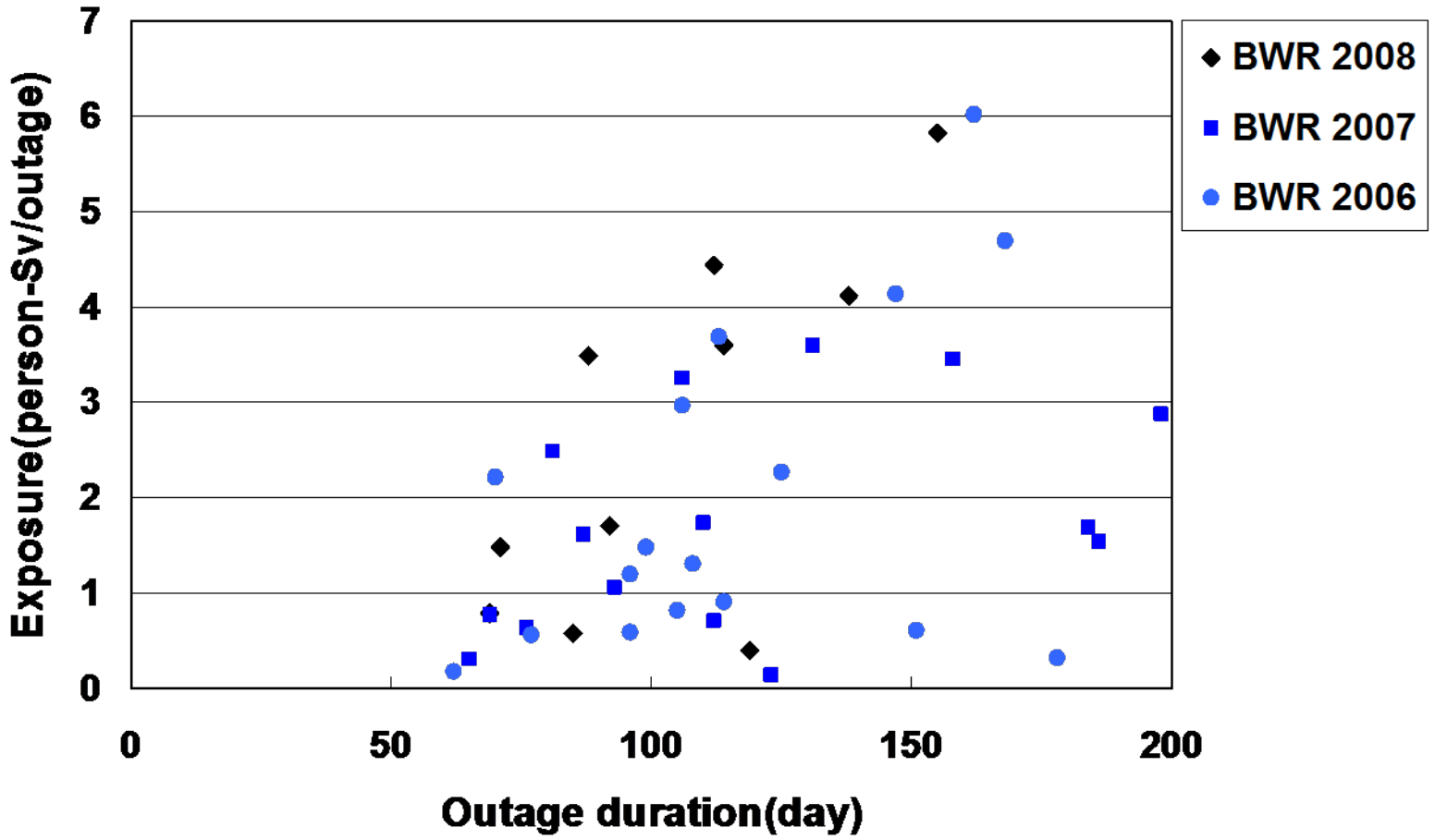
Operation Period and Maintenance Period by Country (1996-2005)



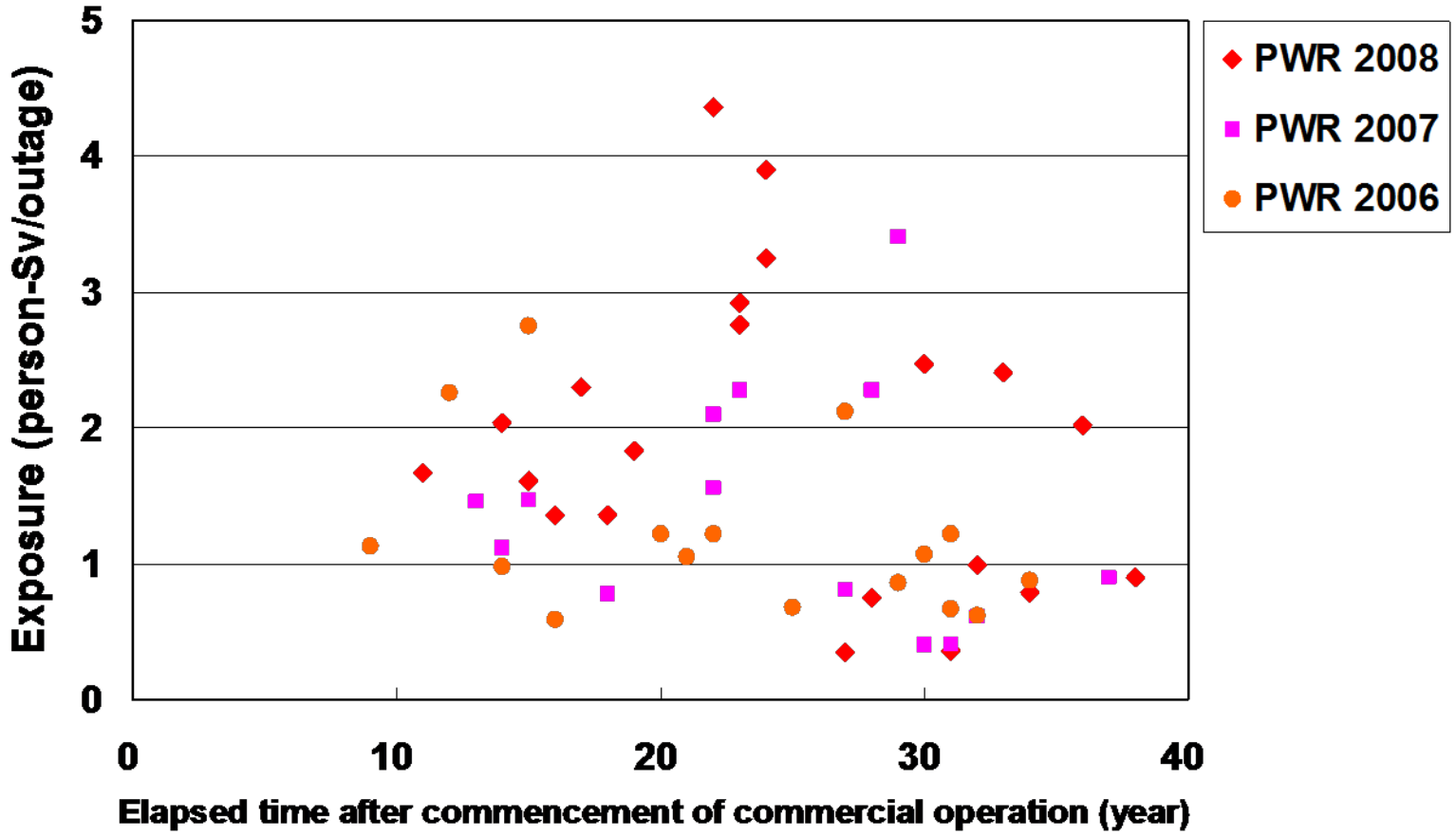
Correlation between Outage duration and Exposure per outage (Japanese PWR)



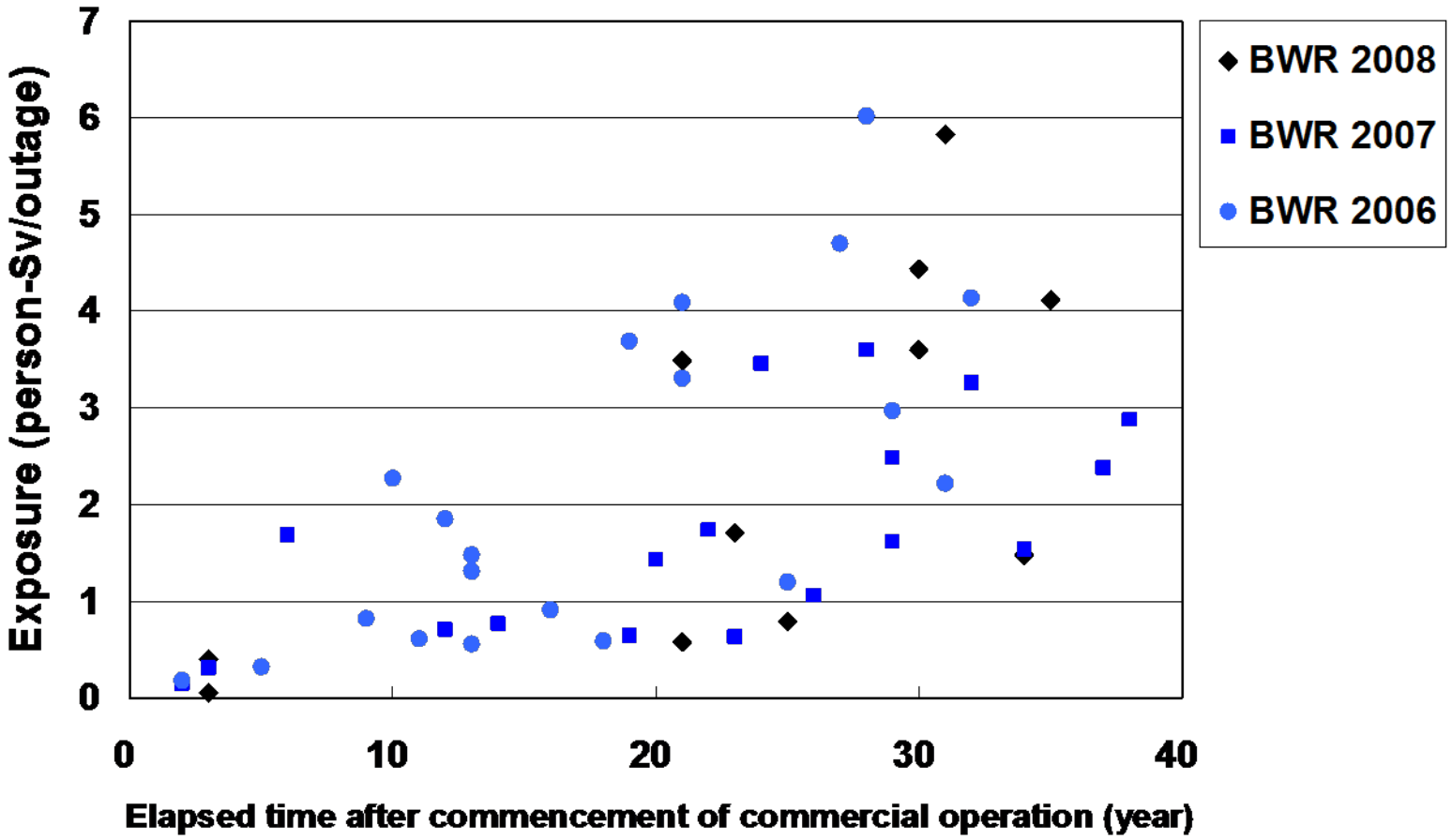
Correlation between Outage duration and Exposure per outage (Japanese BWR)



Correlation between Elapsed time after commencement of commercial operation and Exposure per outage (Japanese PWR)



Correlation between Elapsed time after commencement of commercial operation and Exposure per outage (Japanese BWR)



New Regulatory Inspection System(1/2)

- The new regulatory inspection system was implemented in January 2009.
- The new inspection system is the system for safety activities based on the maintenance program, aiming for safety assurance as important action, and provides arrangements for guidelines on root cause analyses.

New Regulatory Inspection System(2/2)

- In this system the inspection is shifted from a uniform inspection to a fine inspection according to the characteristic of each plant allowing 18 or 24 month operating periods which is 13 month now.
- It is expected that the maintenance optimisation by the implemented improved inspection system will promote to decrease the exposure in Japanese plants.

4. 2009 ISOE Asian ALARA Symposium

- **Date: September 8-11 , 2009**
- **Place: Aomori, Japan**
- **Organizer: JNES/ISOE-ATC**

- **Participants:**
  35 individuals from Korea, USA and Japan

September 10: Tour to Higashidori unit1 NPP
September 11: Tour to Muroran Plant of Japan Steel Works
(They are providing nuclear equipment)

4. 2009 ISOE Asian ALARA Symposium

Presentation Award

(Best Presentation)

- Dose Rate Reduction Methods at Shimane Nuclear Power Station

  Tadashi Kanaoka (The Chugoku Electric Power Company, INC)

(Special award)

- Hot Topic Report of Bottom Header Defected, YGN 5 in 2003

  Youn Young Ho (Korea Hydro & Nuclear Power Co. Ltd.)

(Technical award)

- Pre-Filming Method of Deducting Metal Release from Alloy 690 for SG in Primary Water of PWR

  Akihiro Uehira (Sumitomo Metal Industries Ltd.)

- Reduction of radiation exposure by feed water heater tubes applied reducing content and pre-filming technology to reduce Cr and Co release

  Tetsuo Yokoyama (Sumitomo Metal Industries Ltd.)

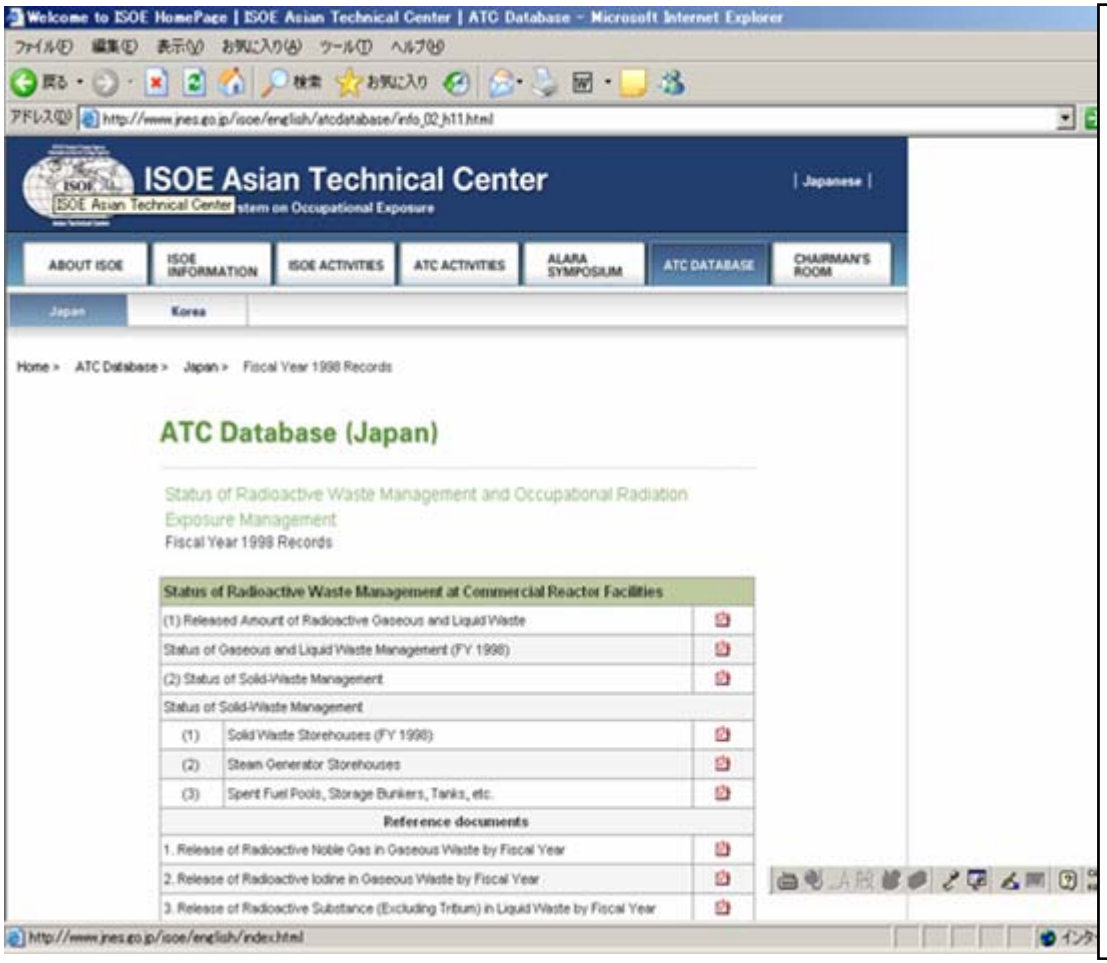
5. Other Topics (ATC Database)

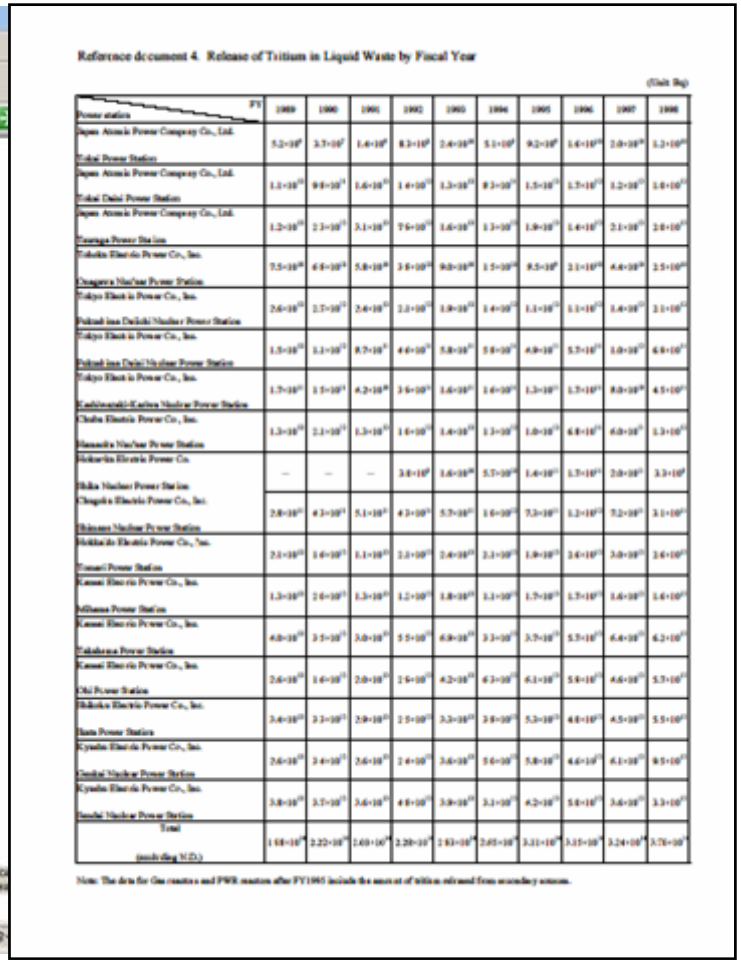
ATC provided the proprietary database for the Information for Occupational exposure on the ATC website.

- **"Status of Radioactive Waste Management and Occupational Radiation Exposure Management at Nuclear Facilities" in Japan between FY1979 - FY2007**
- **Dosimetric trends of NPPs in Chinese Taipei**

5. Other Topics (ATC Database)

"Status of Radioactive Waste Management and Occupational Radiation Exposure Management at Nuclear Facilities" in Japan




Reference document 4. Release of Tritium in Liquid Waste by Fiscal Year

(Unit: Bq)

FY / Power station	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Japan Atomic Power Company Co., Ltd. Tokai Power Station	$5.2\times10^{}$	$3.7\times10^{}$	$1.4\times10^{}$	$8.3\times10^{}$	$2.4\times10^{}$	$5.1\times10^{}$	$9.2\times10^{}$	$1.6\times10^{}$	$2.0\times10^{}$	$1.2\times10^{}$
Japan Atomic Power Company Co., Ltd. Tokai Daini Power Station	$1.1\times10^{}$	$9.8\times10^{}$	$1.6\times10^{}$	$1.4\times10^{}$	$1.3\times10^{}$	$8.3\times10^{}$	$1.5\times10^{}$	$1.7\times10^{}$	$1.2\times10^{}$	$1.8\times10^{}$
Japan Atomic Power Company Co., Ltd. Tsuruga Power Station	$1.2\times10^{}$	$2.3\times10^{}$	$3.1\times10^{}$	$7.6\times10^{}$	$1.6\times10^{}$	$1.3\times10^{}$	$1.9\times10^{}$	$1.4\times10^{}$	$2.1\times10^{}$	$2.8\times10^{}$
Tohoku Electric Power Co., Inc. Onagawa Nuclear Power Station	$7.5\times10^{}$	$4.9\times10^{}$	$5.8\times10^{}$	$3.9\times10^{}$	$9.0\times10^{}$	$1.5\times10^{}$	$8.5\times10^{}$	$2.1\times10^{}$	$4.4\times10^{}$	$2.5\times10^{}$
Tokyo Electric Power Co., Inc. Fukushima Daiichi Nuclear Power Station	$2.6\times10^{}$	$2.7\times10^{}$	$2.4\times10^{}$	$2.1\times10^{}$	$1.9\times10^{}$	$1.4\times10^{}$	$1.1\times10^{}$	$1.1\times10^{}$	$1.4\times10^{}$	$2.1\times10^{}$
Tokyo Electric Power Co., Inc. Fukushima Daini Nuclear Power Station	$1.5\times10^{}$	$1.1\times10^{}$	$8.7\times10^{}$	$4.6\times10^{}$	$5.8\times10^{}$	$5.9\times10^{}$	$4.9\times10^{}$	$5.7\times10^{}$	$1.0\times10^{}$	$6.8\times10^{}$
Tokyo Electric Power Co., Inc. Kashiwazaki-Kariwa Nuclear Power Station	$1.7\times10^{}$	$1.5\times10^{}$	$4.2\times10^{}$	$3.6\times10^{}$	$1.6\times10^{}$	$1.6\times10^{}$	$1.3\times10^{}$	$1.7\times10^{}$	$8.0\times10^{}$	$4.5\times10^{}$
Chubu Electric Power Co., Inc. Hamaoka Nuclear Power Station	$1.3\times10^{}$	$2.1\times10^{}$	$1.3\times10^{}$	$1.6\times10^{}$	$1.4\times10^{}$	$1.3\times10^{}$	$1.0\times10^{}$	$6.8\times10^{}$	$6.0\times10^{}$	$1.3\times10^{}$
Hokuriku Electric Power Co. Shika Nuclear Power Station	–	–	–	$3.8\times10^{}$	$1.6\times10^{}$	$5.7\times10^{}$	$1.4\times10^{}$	$1.7\times10^{}$	$2.0\times10^{}$	$3.3\times10^{}$
Chugoku Electric Power Co., Inc. Shimane Nuclear Power Station	$2.0\times10^{}$	$4.3\times10^{}$	$5.1\times10^{}$	$4.3\times10^{}$	$5.7\times10^{}$	$1.0\times10^{}$	$7.3\times10^{}$	$1.2\times10^{}$	$7.2\times10^{}$	$3.1\times10^{}$
Hokkaido Electric Power Co., Inc. Tomari Power Station	$2.1\times10^{}$	$1.6\times10^{}$	$1.1\times10^{}$	$2.1\times10^{}$	$2.4\times10^{}$	$2.1\times10^{}$	$1.9\times10^{}$	$2.6\times10^{}$	$3.0\times10^{}$	$2.6\times10^{}$
Kansai Electric Power Co., Inc. Mihama Power Station	$1.3\times10^{}$	$2.0\times10^{}$	$1.3\times10^{}$	$1.2\times10^{}$	$1.8\times10^{}$	$1.1\times10^{}$	$1.7\times10^{}$	$1.7\times10^{}$	$1.6\times10^{}$	$1.6\times10^{}$
Kansai Electric Power Co., Inc. Takahama Power Station	$4.0\times10^{}$	$3.5\times10^{}$	$3.0\times10^{}$	$5.5\times10^{}$	$6.8\times10^{}$	$3.3\times10^{}$	$3.7\times10^{}$	$5.7\times10^{}$	$6.4\times10^{}$	$6.2\times10^{}$
Kansai Electric Power Co., Inc. Oi Power Station	$2.6\times10^{}$	$1.6\times10^{}$	$2.0\times10^{}$	$2.9\times10^{}$	$4.2\times10^{}$	$6.3\times10^{}$	$6.1\times10^{}$	$5.9\times10^{}$	$4.6\times10^{}$	$5.7\times10^{}$
Hokuriku Electric Power Co., Inc. Shika Power Station	$3.6\times10^{}$	$3.1\times10^{}$	$2.9\times10^{}$	$2.5\times10^{}$	$3.3\times10^{}$	$3.9\times10^{}$	$5.3\times10^{}$	$4.8\times10^{}$	$4.5\times10^{}$	$5.5\times10^{}$
Kyushu Electric Power Co., Inc. Genkai Nuclear Power Station	$2.6\times10^{}$	$3.4\times10^{}$	$2.6\times10^{}$	$2.4\times10^{}$	$3.6\times10^{}$	$5.6\times10^{}$	$5.8\times10^{}$	$4.6\times10^{}$	$6.1\times10^{}$	$9.5\times10^{}$
Kyushu Electric Power Co., Inc. Sendai Nuclear Power Station	$3.8\times10^{}$	$3.7\times10^{}$	$3.6\times10^{}$	$4.8\times10^{}$	$3.9\times10^{}$	$3.2\times10^{}$	$4.2\times10^{}$	$5.8\times10^{}$	$3.6\times10^{}$	$3.3\times10^{}$
Total (excluding N.D.)	$1.68\times10^{}$	$2.22\times10^{}$	$2.03\times10^{}$	$2.20\times10^{}$	$2.83\times10^{}$	$2.65\times10^{}$	$3.21\times10^{}$	$3.15\times10^{}$	$3.24\times10^{}$	$3.76\times10^{}$

Note: The data for Gas cooled reactors and PWR reactors after FY1995 include the amount of tritium released from secondary systems.

http://www.jnes.go.jp/isoe/english/index.html

5. Other Topics (ATC Database)

"Status of Radioactive Waste Management and Occupational Radiation Exposure Management at Nuclear Facilities" in Japan

Following Data are shown in the ATC Data Base

< Status of Radioactive Waste Management>
(Power Reactors, Fuel Cycle Facilities)

- **Release of Gaseous Radioactive Waste**
- **Release of Liquid Radioactive Waste**
- **Release of Solid Radioactive Waste**

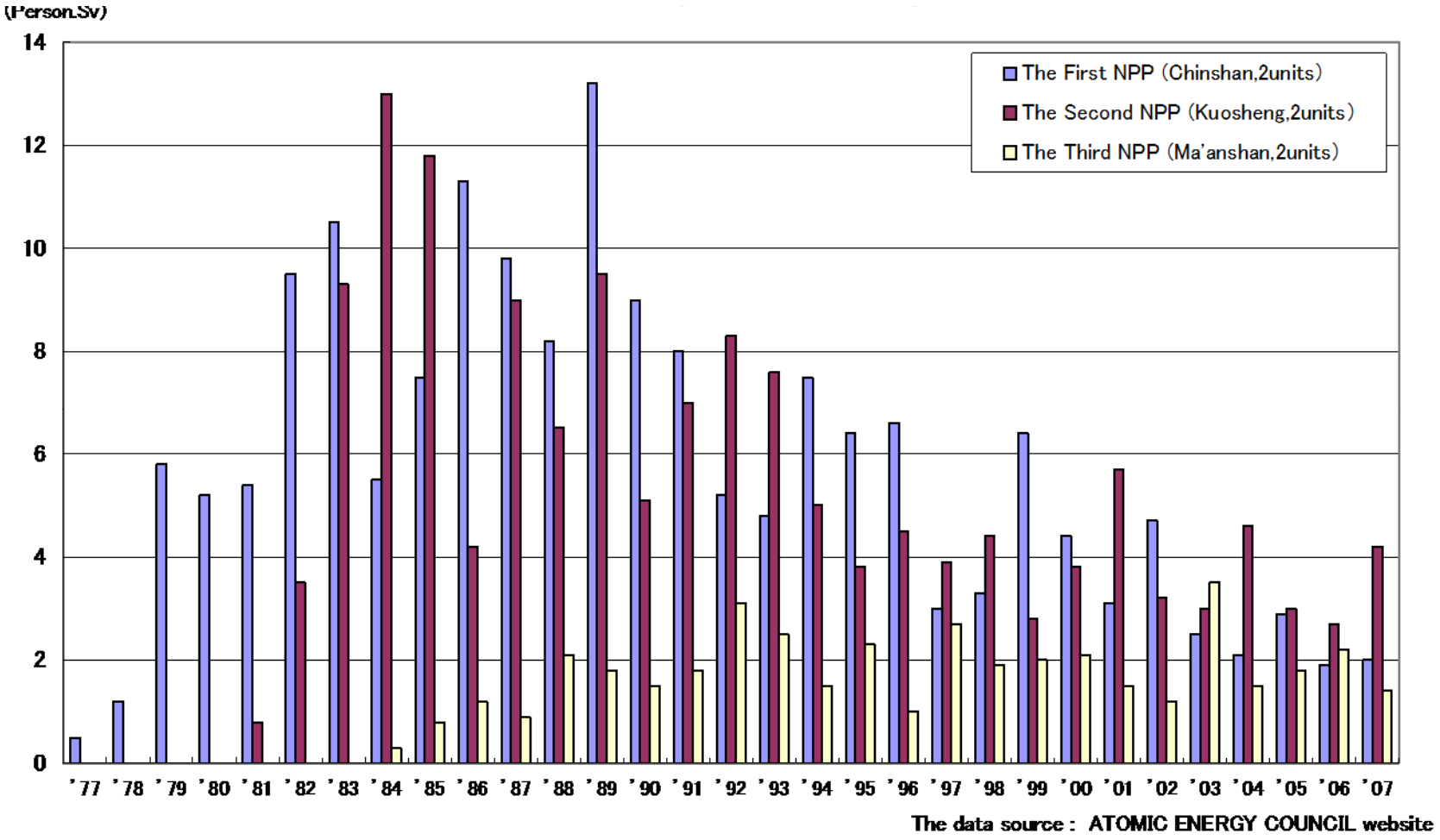
< Status of Occupational Radiation Exposure Management >
(Power Reactors, Fuel Cycle Facilities)

- **Exposure Distribution of Personnel Engaged in Radiation Work**
- **Three-month Radiation Exposure Distribution of Female Personnel Engaged in Radiation Work**

Data obtained since 1979 have been provided.

5 . Other Topics (ATC Database)

Collective Dose per Site in Chinese Taipei

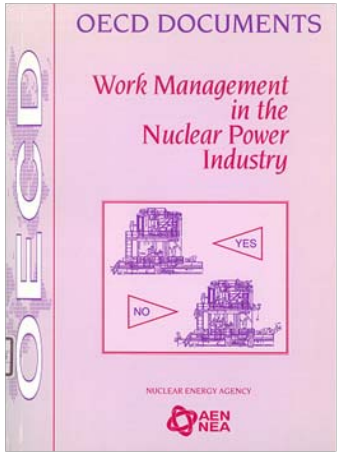


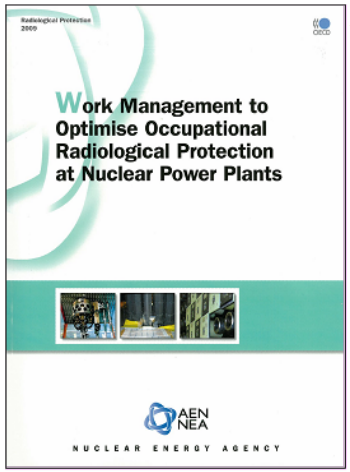
5 . Other Topics (Greenbook)

1997: "Work Management in the Nuclear Industry" (Pinkbook) was issued.

- Ten years has past, and knowledge, technologies and experiences in occupational radiation protection has been obtained.

- Revised to "Greenbook"





5. Other Topics (Greenbook)

This book provides practical guidance in the key areas of work management to optimise occupational radiation protection.

1. Introduction
2. Regulatory aspects
3. ALARA management policy
4. Worker involvement and performance .
5. Work planning and scheduling
6. Work preparation
7. Work implementation
8. Work assessment and feedback
9. Ensuring continuous improvement
10. Conclusions

Thank you for your attention !!