

# Analysis of Collective Dose Trends using the ISOE Database

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# The ISOE Website (www.isoe-network.net)



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 Information System on Occupational Exposure



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 For the latest information concerning the status of Fukushima NPP Accident, see the following websites:
 

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- [Japan Atomic Industrial Forum](#)
- [Tokyo Electric Power Company](#)
- [Japan Ministry of Education, Culture, Sports, Science & Technology](#)
- [International Atomic Energy Agency](#)

### Welcome to the ISOE Website






*The Information System on Occupational Exposure (ISOE) System was created in 1992 to **provide a forum for radiation protection professionals** from nuclear electricity utilities and national regulatory authorities worldwide to **share dose reduction information, operational experience and information to improve the optimisation of radiological protection at nuclear power plants.***

ISOE is jointly sponsored by the OECD Nuclear Energy Agency and the International Atomic Energy Agency

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# Access to the ISOE Database



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## Welcome to the ISOE Database


**ISOE DATABASE**  
 (You will be asked to re-enter your ISOE username and password)

“ The ISOE database includes occupational exposure information for **401 operating units and 81 units in cold-shutdown** or some stage of decommissioning in **29 countries**, covering about **91% of the world's operating commercial power reactors**. ”

**2012 Data for operational reactors available in the current database (as of 9 July 2013)**

<b>Armenia</b> (missing)	<b>Finland</b> (complete)	<b>Pakistan</b> (missing)	<b>Spain</b> (2 NPPs missing)
<b>Belgium</b> (4 reactors missing)	<b>France</b> (complete)	<b>Rep. of Korea</b> (missing)	<b>Sweden</b> (complete)
<b>Brazil</b> (complete)	<b>Germany</b> (complete)	<b>Romania</b> (complete)	<b>Switzerland</b> (1 NPP missing)
<b>Bulgaria</b> (complete)	<b>Hungary</b> (complete)	<b>Russian Federation</b> (missing)	<b>Ukraine</b> (complete)
<b>Canada</b> (missing)	<b>Japan</b> (1st set of data available)	<b>Slovak Rep.</b> (complete)	<b>United Kingdom</b> (complete)
<b>China</b> (complete)	<b>Mexico</b> (missing)	<b>Slovenia</b> (complete)	<b>USA</b> (missing)
<b>Czech Rep.</b> (complete)	<b>Netherlands</b> (missing)	<b>South Africa</b> (complete)	

# Content of the ISOE Database

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- **ISOE 1:** Dosimetric information from commercial NPPs in operation or in some stage of decommissioning, including:
  - annual collective dose for normal operation
  - maintenance/refuelling outage dose
  - forced outage dose
  - annual collective dose for certain tasks and worker categories

# Who Can Access the Database?

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- **ISOE Participants** can access the DB on-line (ISOE website) and on CD-ROM (Microsoft ACCESS)
  - Web version is routinely updated
  - CD-ROM is distributed annually after all data received<sup>1</sup>
- **Participating Utilities:**
  - Full access to global database
- **Participating Authorities:**
  - Full access to ISOE 1 data from national licensees
  - Limited access to ISOE 1 data from other countries
    - No access to dose per task and job, dose per occupational category and dose rates


<sup>1</sup> CD-Rom needed by 3 countries: Armenia, Russian Federation and by some German plants

# Database Analyses and Benchmarking

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- The extensive data in ISOEDAT provides a solid basis for analyses on issues in operational RP such as dose trends, doses related to certain jobs and tasks, identification of good performance, etc.
- Several ways to use the database:
  - a) MADRAS analysis package : Main trends in occupational exposure
  - b) Direct access to ISOE 1 questionnaires, including contact information and complementary data
  - c) Direct access to the whole database using the data extraction module

# Database Analyses and Benchmarking



ISOE

ISOE

+ ISOE 1 Questionnaires

→ Database

→ Create

→ Import

→ Export

+ Analysis Modules

→ MADRAS Analyses

→ Data completeness

→ Data extraction

+ Admin

→ Users

+ Contact



→ ISOE > Analysis Modules

• MADRAS Analyses





ANNUAL COLLECTIVE DOSE

• Total annual collective dose



For a plant unit

 Compared with other units (#U-01)
  Compared with other units in its sister unit group (#U-20)



For the whole database

 By geographical region (#4-f3)
  By reactor type (#4-f4)
  Breakdown by geographical region for 1 year (#4-f5)
  Breakdown by reactor type for 1 year (#4-f6)



Compared with the number of operating reactors

 For the whole database (#4-f2)
  For a country (#U-15)


Contribution of outside personnel collective dose

 For a plant unit (#U-08)
  By reactor type and by country for 1 year (#6-t3)

By reactor age for a plant unit



 Compared with other units for 1 reactor type (#U-66)
  Compared with other units for 1 country (#U-67)

Cumulated dose

 By geographical region (#4-f1)

• Average annual collective dose per reactor

For a plant unit

 Compared with its sister unit group and other sister unit groups (#U-02)
  Compared with its sister unit group and its reactor type (#U-05)

# MADRAS Data Analysis Package

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- A set of pre-defined data queries to facilitate analysis of main trends in occupational exposure, benchmarking between plants, sister units, etc.
  - Benchmarking at unit level
  - Total annual collective dose
  - Annual average collective dose per reactor
  - Rolling average collective dose per reactor
  - Total annual collective dose vs. number of operating reactors
  - Total annual collective dose by reactor age
  - Average annual collective dose per TWh
  - Contribution of outside personnel and outages to total collective dose
  - Dose rates



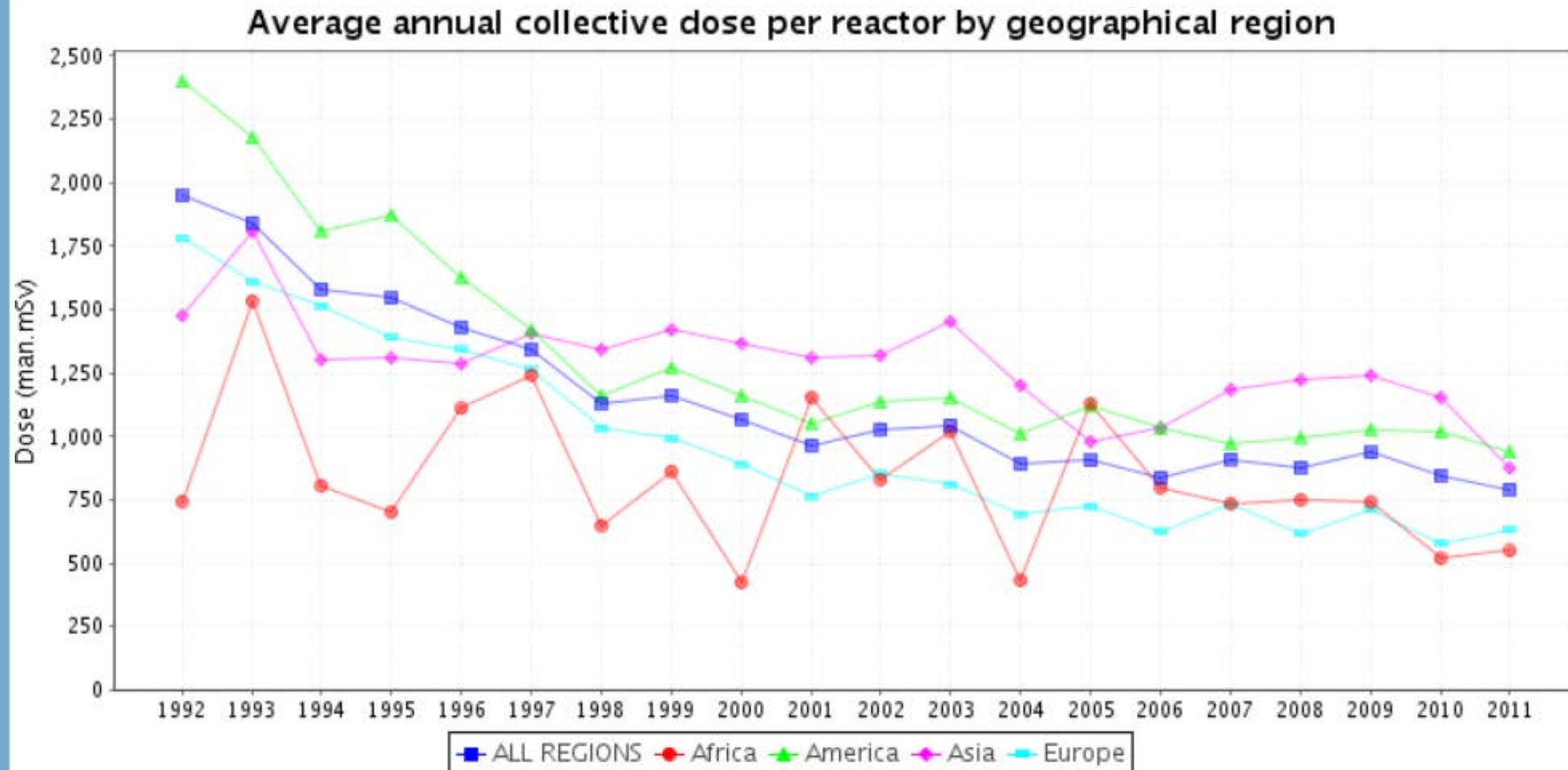
# Using ISOEDAT as a Benchmarking Tool

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- Analyses at **country or regional level**:
  - Trends in Annual average collective dose per reactor / Annual total collective dose*
  - Between countries or regions: by country/region for a given reactor type, or all reactors, including rolling average over several years
  - Within a country: Specific unit against another unit or by type of reactor
- Analyses at **utility level**:
  - Specific utility against other utilities
  - Specific utility by reactor type
- Analyses at **unit level**
  - Specific unit against another unit / sister group / reactor type
  - Benchmarking at the job and task level

# Global Dose Trends by Geographical Region

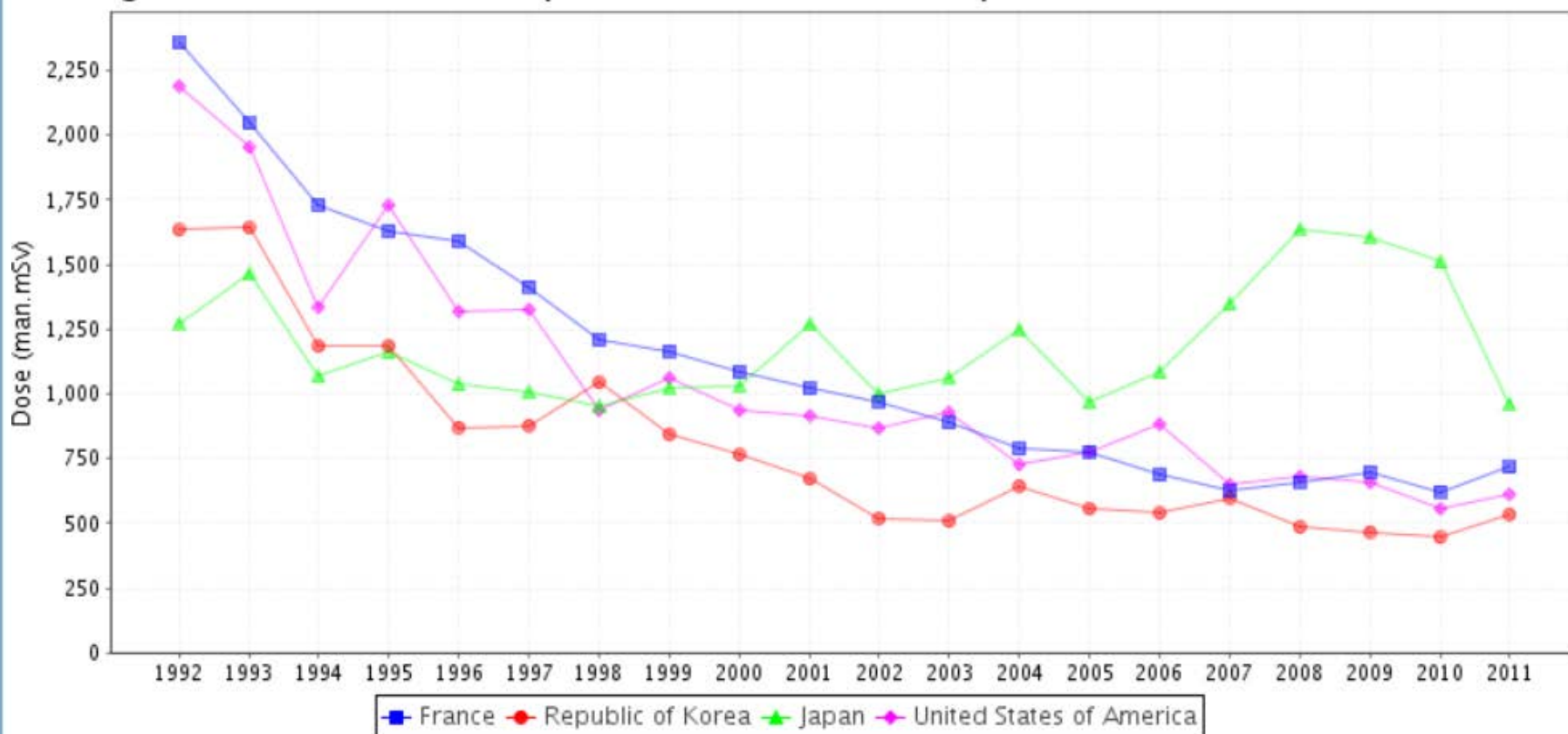
- The annual average collective dose per operating reactor has consistently decreased over the time period covered in by ISOE



# Country Dose Trends by Reactor Type (PWRs)

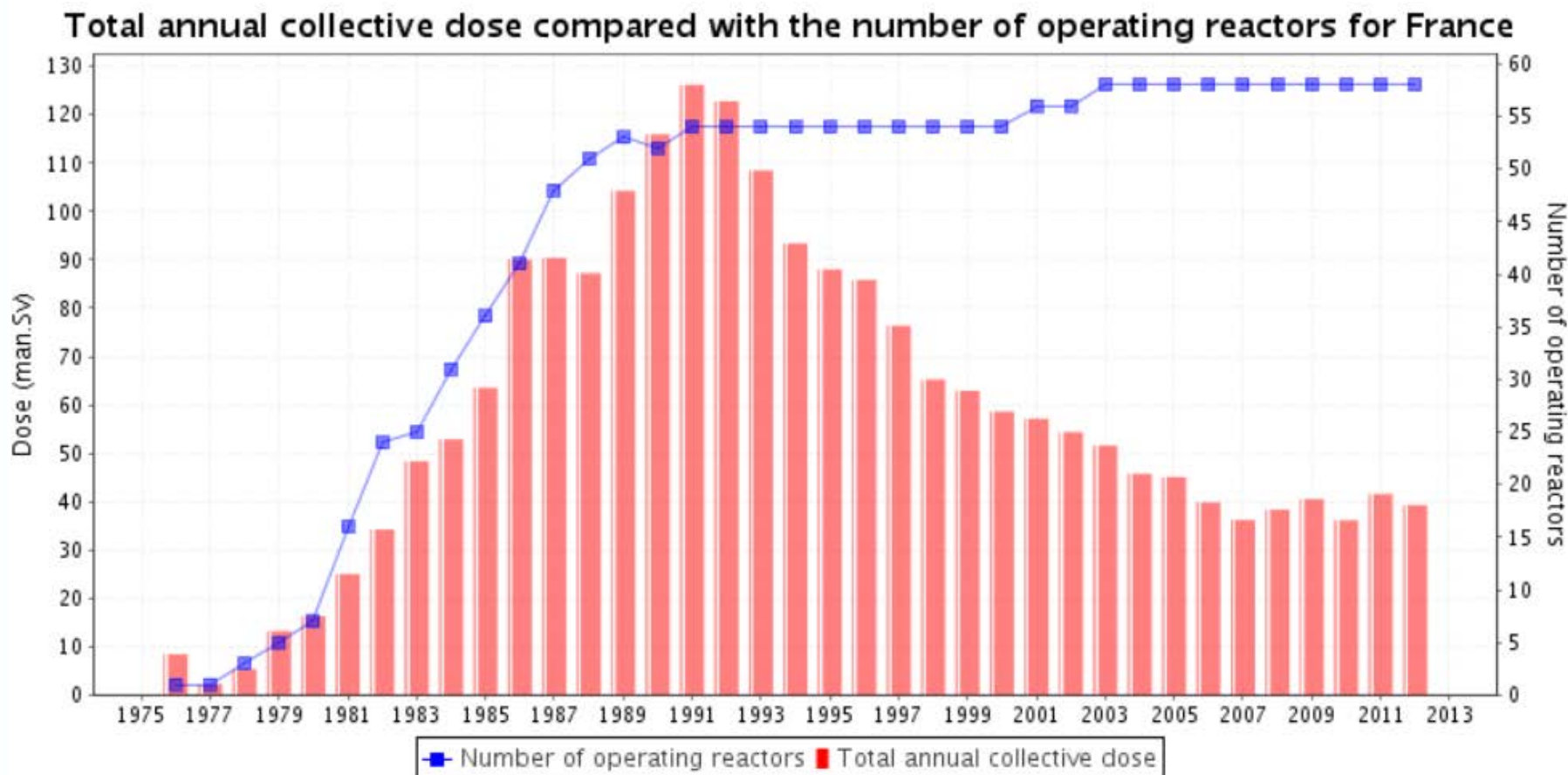
- For most countries, the annual average collective dose per operating reactor decreased over the time period

Average annual collective dose per reactor for France compared with other countries for PWR



## Total Dose vs. Number of Operating Reactors

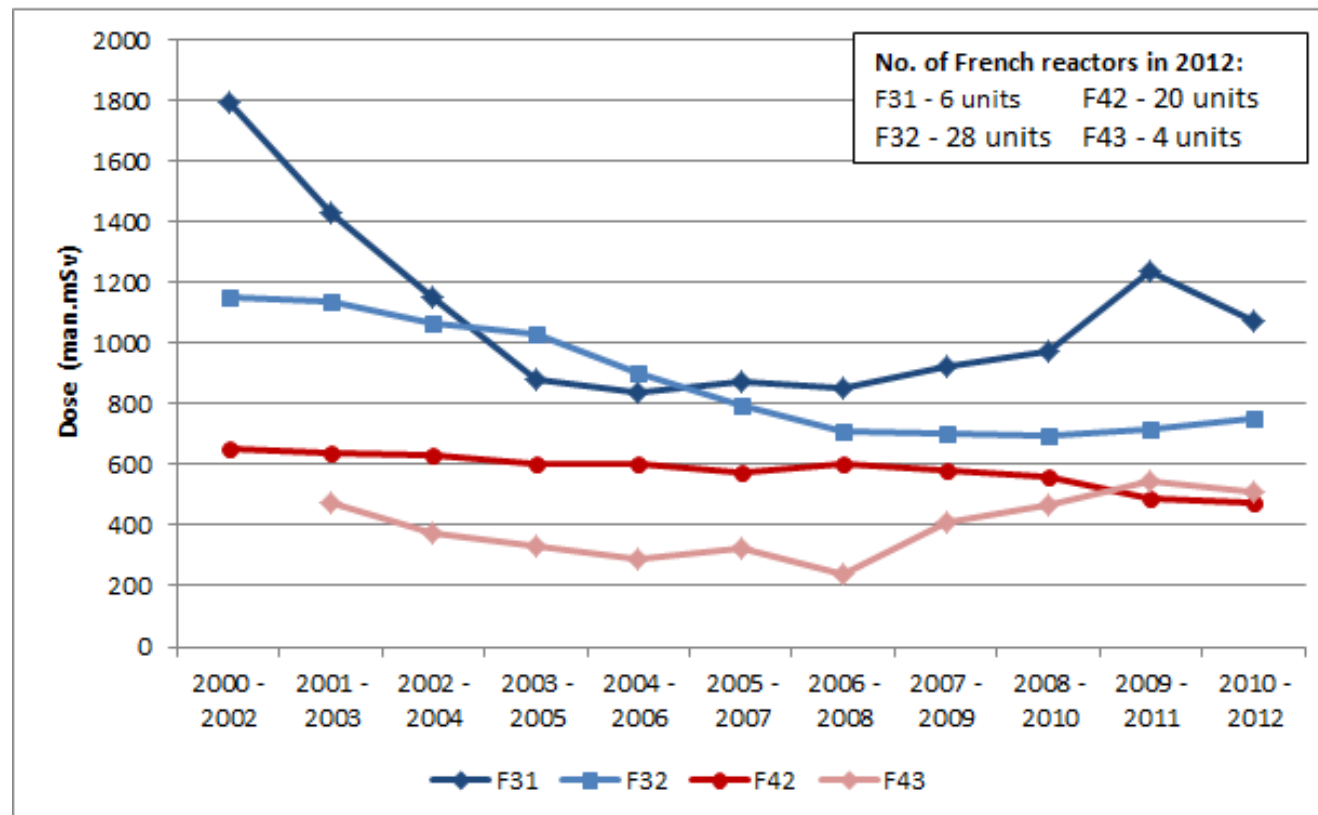
- Decrease of total collective dose despite an ageing fleet and an increase of maintenance programme



# France: Trends by Sister Unit Groups

- **Impact of the Design:** Clear decrease of average collective dose per reactor by sister unit group from F31 (oldest generation) to F43 (newest generation)

## 3-Year rolling average collective dose per reactor for French sister unit groups



# Quartile Ranking

## 2010-2012 Average Collective Dose for France

Quartile ranking for France					
Quartile	Plant unit	2010 - 2012 (man.mSv)	2009 - 2011 (man.mSv)	Percent change from 2009 - 2011	2009 - 2011 Quartile (if changed)
1	Penly 2	338.20	419.09	-19%	2
	Chooz B2	342.89	511.17	-33%	
	Paluel 4	343.88	354.33	-3%	
	Saint Alban 2	363.21	354.06	3%	
	Nogent 1	375.09	573.95	-35%	2
	Flamanville 2	379.93	388.35	-2%	
	Cattenom 4	380.10	388.27	-2%	
	Golfech 2	388.52	311.66	25%	
	Cattenom 2	394.37	366.06	8%	3
	Belleville 2	401.43	684.57	-41%	
	Saint Alban 1	402.83	510.33	-21%	
	Paluel 3	426.60	417.76	2%	
	Chinon B3	431.50	897.08	-52%	4
	Chinon B1	459.30	618.06	-26%	2
	Penly 1	497.62	638.46	-22%	3

# International Benchmarking 2010-2011 Average Collective Dose Ranking

Top 20 plant units for PWR

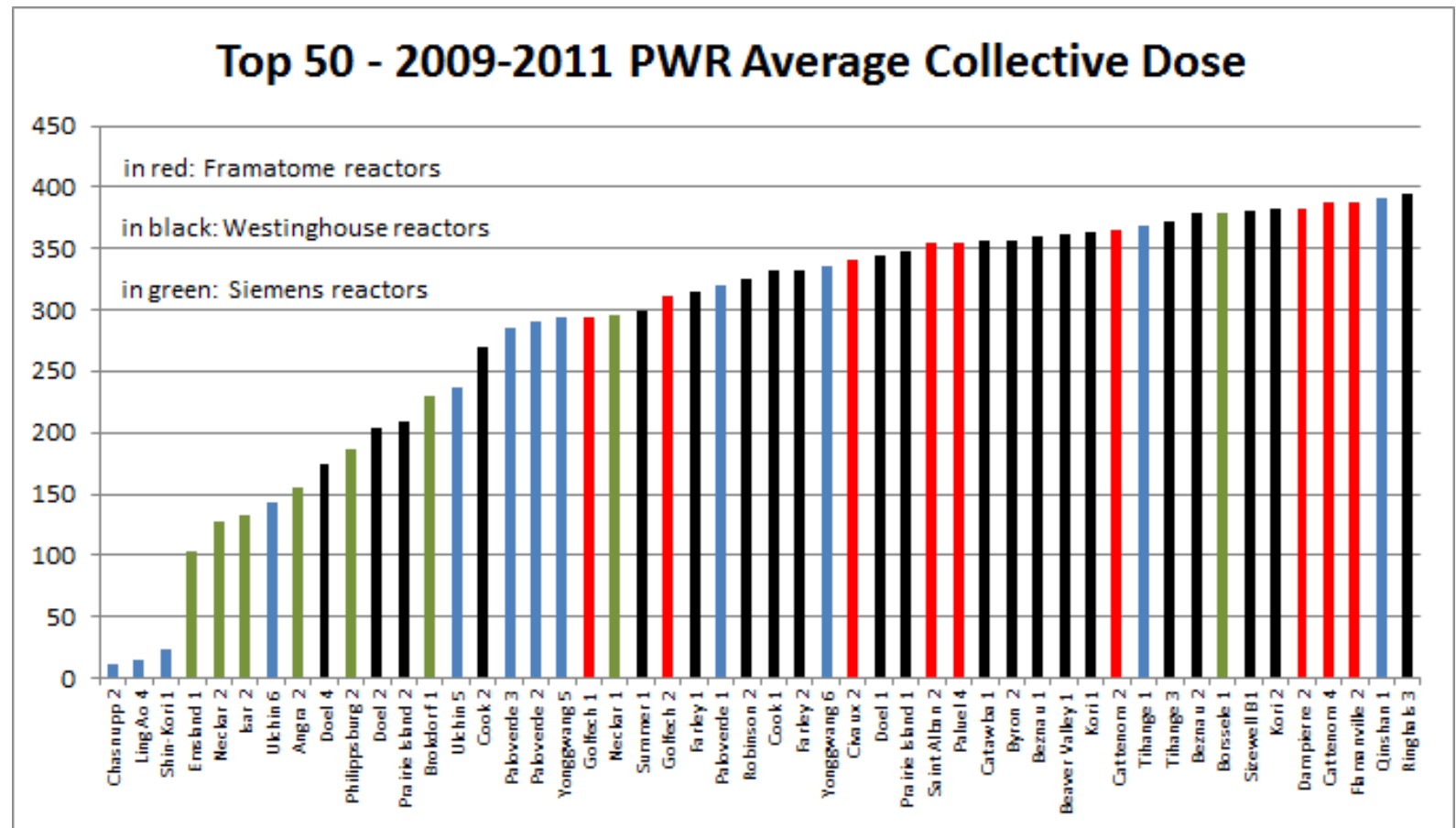
Plant unit	2009 - 2011 (man.mSv)
Chasnupp 2	11.03
Ling Ao 4	14.26
Shin-Kori 1	23.06
Emsland 1	103.08
Neckar 2	127.05
Isar 2	132.94
Ulchin 6	142.97
Angra 2	156.13
Doel 4	173.68
Philippsburg 2	187.03
Doel 2	203.15
Prairie Island 2	209.82
Brokdorf 1	229.14
Ulchin 5	237.51
Cook 2	269.03
Paloverde 3	285.57
Paloverde 2	291.48
Yonggwang 5	293.85
Golfech 1	294.72
Neckar 1	295.04

**Plant unit ranking  
for a reactor type**

**Top 20 for PWRs**

> German & Westinghouse  
reactors at top 20  
if we exclude from the ranking  
units without outage refueling

# International Benchmarking



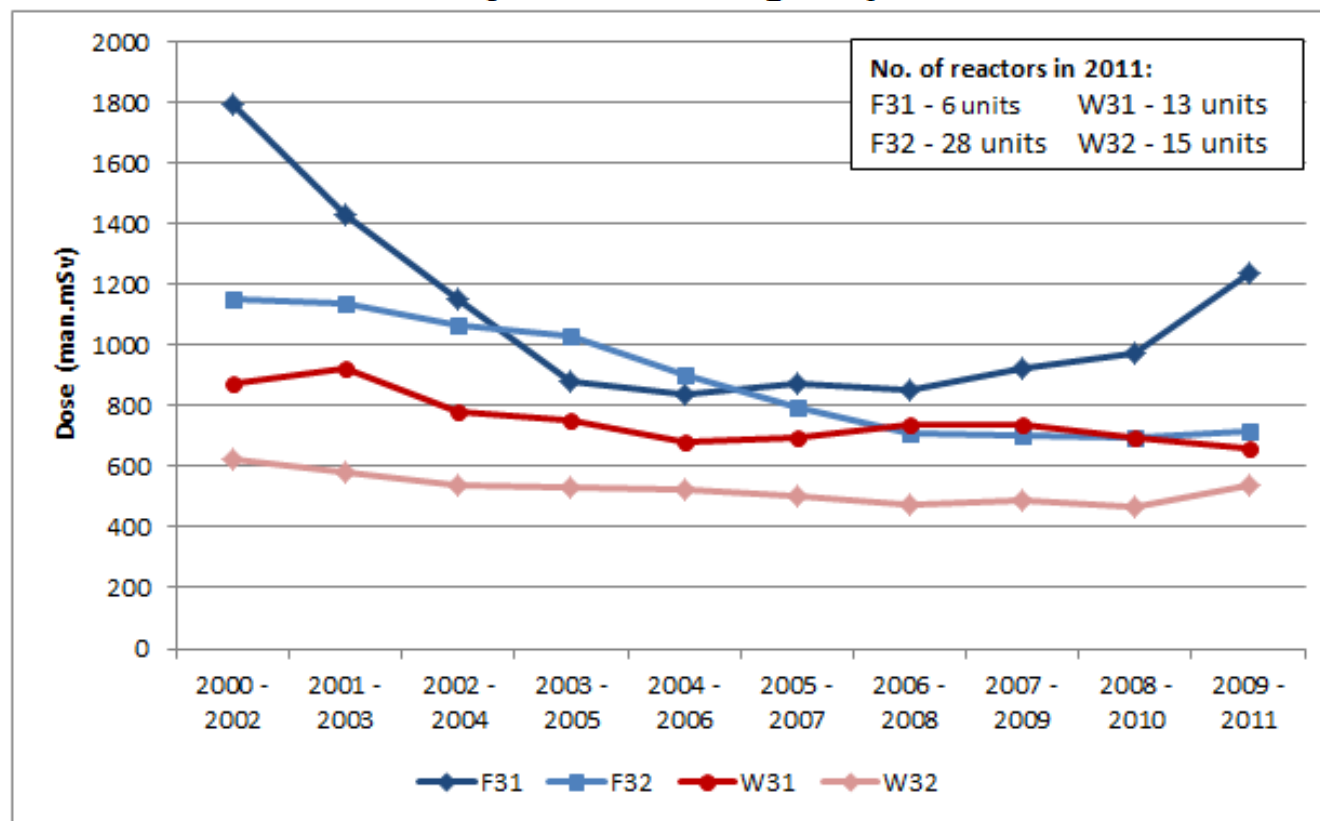


# Collective Dose Trends by Sister Unit Group

## Comparison Framatome – Westinghouse reactors

- **3-Loops reactors:** 1<sup>st</sup> and 2<sup>nd</sup> generation of Westinghouse reactors shows lower dose than respective generations of Framatome reactors

**3-Year rolling average collective dose per reactor  
by sister unit group**



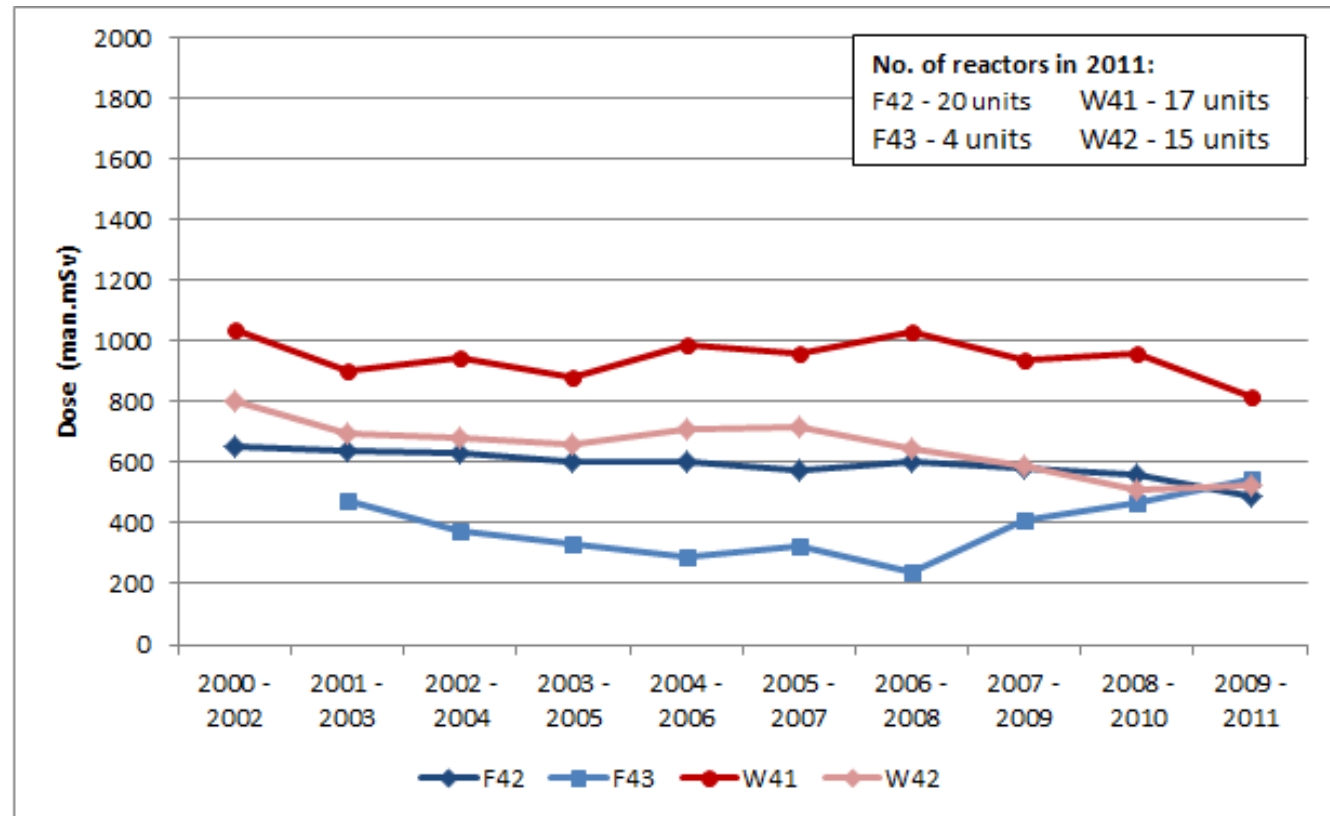
The reactors from South-Africa, China and South Korea have been excluded from F32

# Collective Dose Trends by Sister Unit Group

## Comparison Framatome – Westinghouse reactors

- **4-Loops reactors:** 2<sup>nd</sup> generation of Framatome reactors shows lower dose than Westinghouse reactors except for recent periods

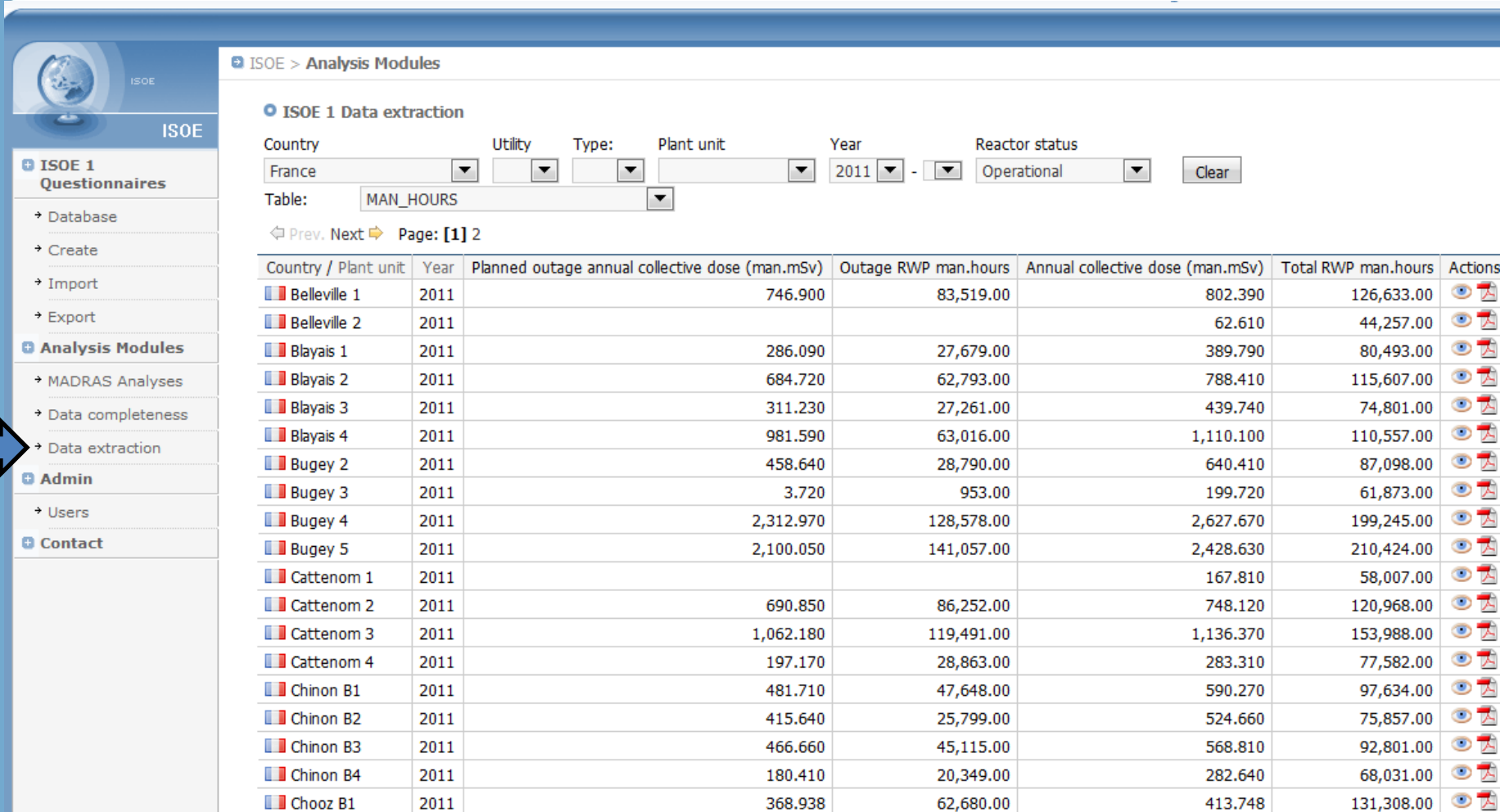
**3-Year rolling average collective dose per reactor  
by sister unit group**



## New MADRAS Analyses

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- MADRAS Analysis module is improved every year with new developments based on user feedback and requests
- **New analyses planned for 2013:**  
A set of new queries to improve outage benchmarking



ISOE > Analysis Modules

ISOE 1 Data extraction

Country: France Utility: Type: Plant unit: Year: 2011 Reactor status: Operational Clear

Table: MAN\_HOURS

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Country / Plant unit	Year	Planned outage annual collective dose (man.mSv)	Outage RWP man.hours	Annual collective dose (man.mSv)	Total RWP man.hours	Actions
Belleville 1	2011	746.900	83,519.00	802.390	126,633.00	
Belleville 2	2011			62.610	44,257.00	
Blayais 1	2011	286.090	27,679.00	389.790	80,493.00	
Blayais 2	2011	684.720	62,793.00	788.410	115,607.00	
Blayais 3	2011	311.230	27,261.00	439.740	74,801.00	
Blayais 4	2011	981.590	63,016.00	1,110.100	110,557.00	
Bugey 2	2011	458.640	28,790.00	640.410	87,098.00	
Bugey 3	2011	3.720	953.00	199.720	61,873.00	
Bugey 4	2011	2,312.970	128,578.00	2,627.670	199,245.00	
Bugey 5	2011	2,100.050	141,057.00	2,428.630	210,424.00	
Cattenom 1	2011			167.810	58,007.00	
Cattenom 2	2011	690.850	86,252.00	748.120	120,968.00	
Cattenom 3	2011	1,062.180	119,491.00	1,136.370	153,988.00	
Cattenom 4	2011	197.170	28,863.00	283.310	77,582.00	
Chinon B1	2011	481.710	47,648.00	590.270	97,634.00	
Chinon B2	2011	415.640	25,799.00	524.660	75,857.00	
Chinon B3	2011	466.660	45,115.00	568.810	92,801.00	
Chinon B4	2011	180.410	20,349.00	282.640	68,031.00	
Chooz B1	2011	368.938	62,680.00	413.748	131,308.00	

Possibility to extract any type of data of the ISOE 1 Questionnaire in order to perform your own analyses

# The ISOE Website and Database

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Thank you for your attention!



*For more information, please visit:*  
**[www.isoe-network.net](http://www.isoe-network.net)**