COMPUTER MANUAL SERIES No. 22

PRIS-STATISTICS Power Reactor Information System Statistical Reports

User's Manual

IAEA
International Atomic Energy Agency

PRIS-STATISTICS
POWER REACTOR INFORMATION SYSTEM STATISTICAL REPORTS

USER'S MANUAL

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PRIS-STATISTICS
POWER REACTOR INFORMATION SYSTEM STATISTICAL REPORTS

USER'S MANUAL

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2013

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FOREWORD

The IAEA developed the Power Reactor Information System (PRIS)-Statistics application to assist PRIS end users with generating statistical reports from PRIS data. Statistical reports provide an overview of the status, specification and performance results of every nuclear power reactor in the world.

This user's manual was prepared to facilitate the use of the PRIS-Statistics application and to provide guidelines and detailed information for each report in the application.

Statistical reports support analyses of nuclear power development and strategies, and the evaluation of nuclear power plant performance. The PRIS database can be used for comprehensive trend analyses and benchmarking against best performers and industrial standards.

This user's manual was developed by IAEA staff members and external experts with the support of two consultancy meetings. The IAEA wishes to express its gratitude to L. Riggin (Canada) and to the others who contributed to the drafting and reviewing of this manual.

The IAEA officer responsible for this publication was J. Mandula of the Division of Nuclear Power.

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1. INTRODUCTION

1.1. Power Reactor Information System (PRIS)

PRIS is a comprehensive data source for nuclear power reactors in the world. It includes specification and performance history data on operating reactors as well as reactors under construction or reactors being decommissioned Ref. [1].

One of the most important purposes of the PRIS database is to provide data and tools for nuclear power plant (NPP) overview, performance analyses, as well as trending and benchmarking reactor units worldwide. To achieve this goal, various statistical functions and reports have been included in PRIS.

The reactor specification data consist of basic information (location, operator, owner, suppliers, milestone dates) and design technical characteristics. The performance data include energy production and loss data as well as outage and operational function information.

Due to detailed classification of energy losses and comprehensive outage coding system, (Ref. [2]), a set of internationally accepted performance indicators (Ref. [1]) are calculated from the PRIS performance data. The indicators can be used for benchmarking, international comparison or analyses of nuclear power availability, safety and reliability from reactor specific, national or worldwide perspectives. These analyses can be utilized evaluating the nuclear power competitive advantages compared with other power sources.

The reporting system, PRIS-Statistics, is a web-based oriented on-line application which makes PRIS globally available. The user-friendly interface provides the opportunity to easily generate both global and plant specific reports and graphs on nuclear energy status, performance and trends. The status and performance reports help nuclear power plants with safety performance analysis and nuclear industry with analysis of global trends and strategic planning.

1.2. History of PRIS

PRIS was established in 1970. The database was computerized in 1981 with the first reporting system (PRIS-PC) and on-line statistical reports generation introduced in 1993.

In 2003, the first version of a web-based application for statistical outputs was incorporated into the Web-based Data Acquisition System (WEDAS). The first version had basic functions of reactor grouping and included six statistical reports.

Interest in PRIS outputs has considerably increased in recent years. As a result, it has become evident that further development of the PRIS-Statistics would be necessary to reach the database's full potential. Therefore, activities to improve the current PRIS-Statistics were resumed in 2007. These activities resulted in an enhanced version, PRIS-Statistics, which is now used as the main statistical tool of the PRIS database and a reference source for statistical reports based on PRIS data.

1.3. PRIS Data Model

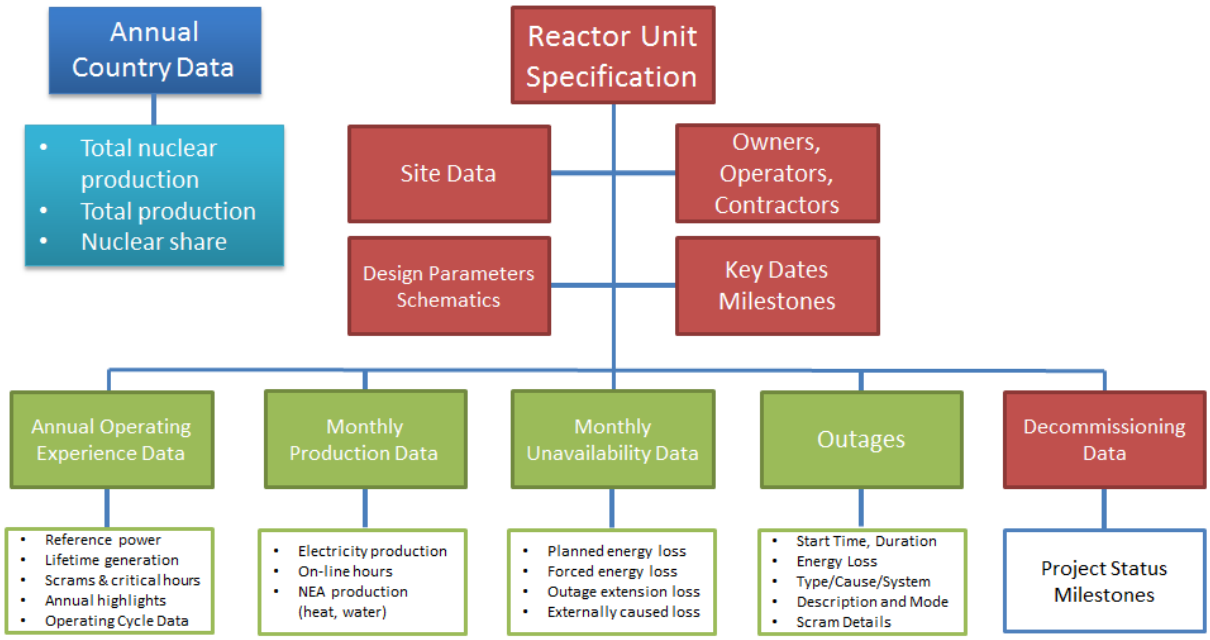


FIG. 1-1. PRIS data structure.

Annual electricity production data is collected from each country with operating NPPs to evaluate the nuclear share of countries' total electricity production.

Reactor specific data consists of reactor specification and production data. Specification information is updated whenever there is a change in any of the parameters. At a minimum, data providers should verify the specification data annually.

Monthly production data refers to the plant availability data model (see Fig. 1-2). Electricity production and plant unavailability related energy loss are reported in the monthly records. Energy losses are also reported in the outage records using an outage coding system. Available energy that is not supplied to the grid due to grid limitation is not reported in the monthly records but recorded in the outage records.

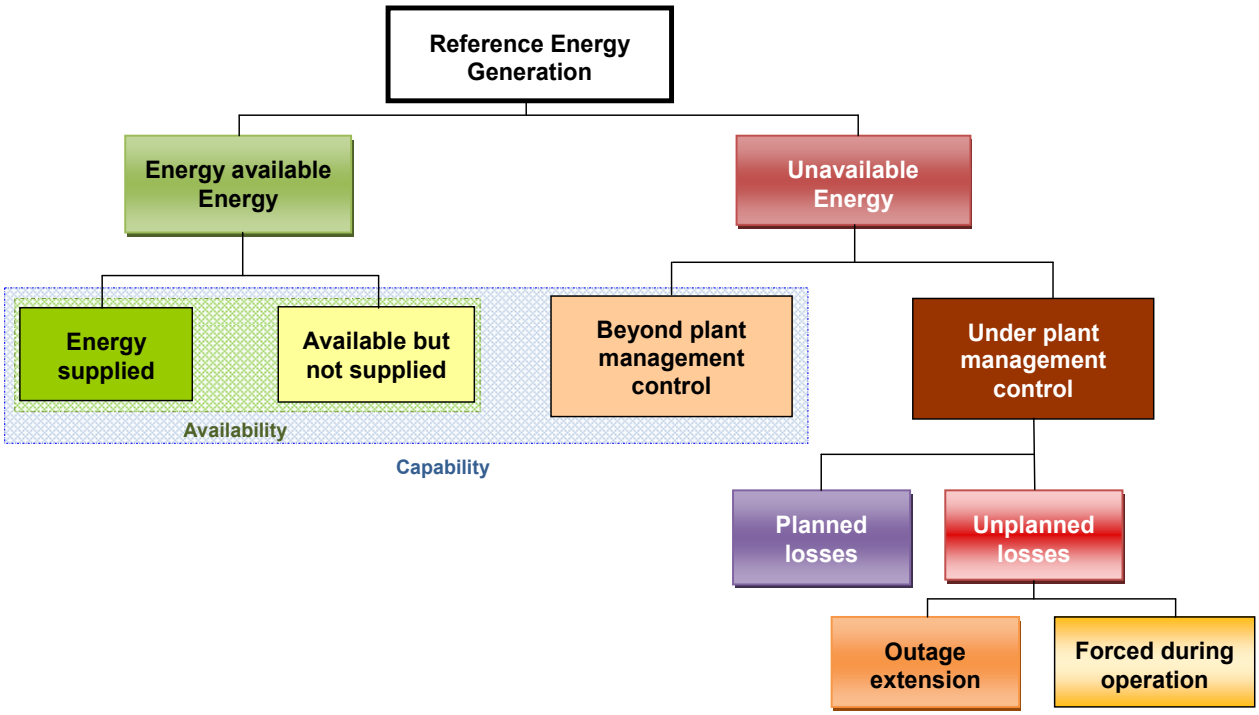


FIG. 1-2. Availability data model.

Each Member State with nuclear power plants is responsible for submitting authorized data into PRIS using WEDAS. There is one PRIS Liaison Officer for each country. Each NPP operating utility can nominate one data provider who is responsible for reporting the plant specific data. The Liaison Officer supervises the data inputs within the country. In addition, there are many accuracy checks within WEDAS that verify the accuracy of the data provided by the Nuclear Power Plants.

1.4. PRIS Outputs

PRIS allows the user to have access to statistical reports and gives the user the ability to analyse data using all nuclear reactor units in the world whether they are under construction, operational, or have been permanently shut down. The most called upon data includes:

- Reactor status overview;
- Reactor status changes;
- Historical development of nuclear power;
- Nuclear Power Plant analyses using well defined and internationally accepted performance indicators;
- Industrial standards – quartiles, median, average;
- Trend analyses;
- Process of reactor decommissioning.

PRIS outputs are available in annual publications, on the PRIS public web-site, and to registered users through on-line applications.

The annual publication “Nuclear Power Reactors in the World” has been published since 1981 and provides an overview of power reactors by country, status and history. The publication “Operating Experience with Nuclear Power Stations in Member States” has been published since 1971 and consists of comprehensive information about operational performance for each individual reactor unit.

Registered users have on-line access to PRIS through the web-based application PRIS-Statistics supporting statistical data reporting.

The PRIS web-site (www.iaea.org/pris) provides information and statistical reports to the public.

2. PRIS-STATISTICS APPLICATION

The PRIS reporting system, called PRIS-Statistics or PRISTA, is available for registered users on the web address: http://prisweb.iaea.org.

PRIS Statistics have four main tabs:

- **Reactor Grouping** - allows the user to create and save their own groups of nuclear power reactors based on a preference for data analyses. For detailed information on creating reactor groups, go to the "3. Reactor Groups" section of the manual.
- **Standard Reports -** (default) – includes the report options for general reports. For detailed information on each report, go to the "4. Standard Reports" section of the manual.
- **Advanced Reports** - includes the report options for more detail and specific reports including outage based reports. For detailed information on each report, go to the "5. Advanced Reports" section of the manual.
- **Map** - provides a tool for visualising where power reactor sites are in the world using Google map features.

2.1. Access to the Application

To get on-line access to PRIS-Statistics, the Subscription Form (http://pris.iaea.org/PRIS/Downloads/PPC-INF.pdf) must be completed and sent to the IAEA through the national authorities of its Member States. Government organizations and NPP operators can send the application directly to the IAEA or to the PRIS administrator (PrisAdmin@iaea.org). The access authorization is completed by the user receiving an ID and password from the IAEA.

PRIS-Statistics application has four levels of access rights:

(1) Basic level;
(2) Non-nuclear organization level;
(3) Nuclear industry level;
(4) Governmental organizations and NPP owners and operators.

Statistical reports and details within the reports depend on the assigned level.

Basic level users can see Standard Reports with aggregated values and without plant specific results. Users from non-nuclear organizations have all rights at the basic level, plus they have Trend Reports available to them. Users from nuclear organizations can see plant specific results and have access to Advanced Reports, except outage related reports. Users from governmental organizations and utilities that operate or own NPPs have all reports available to them including maps.

2.2. Guidelines on How to Generate Reports

Selecting a report in any category brings up to the parametrisation page where the user can define choices, filters and parameters.

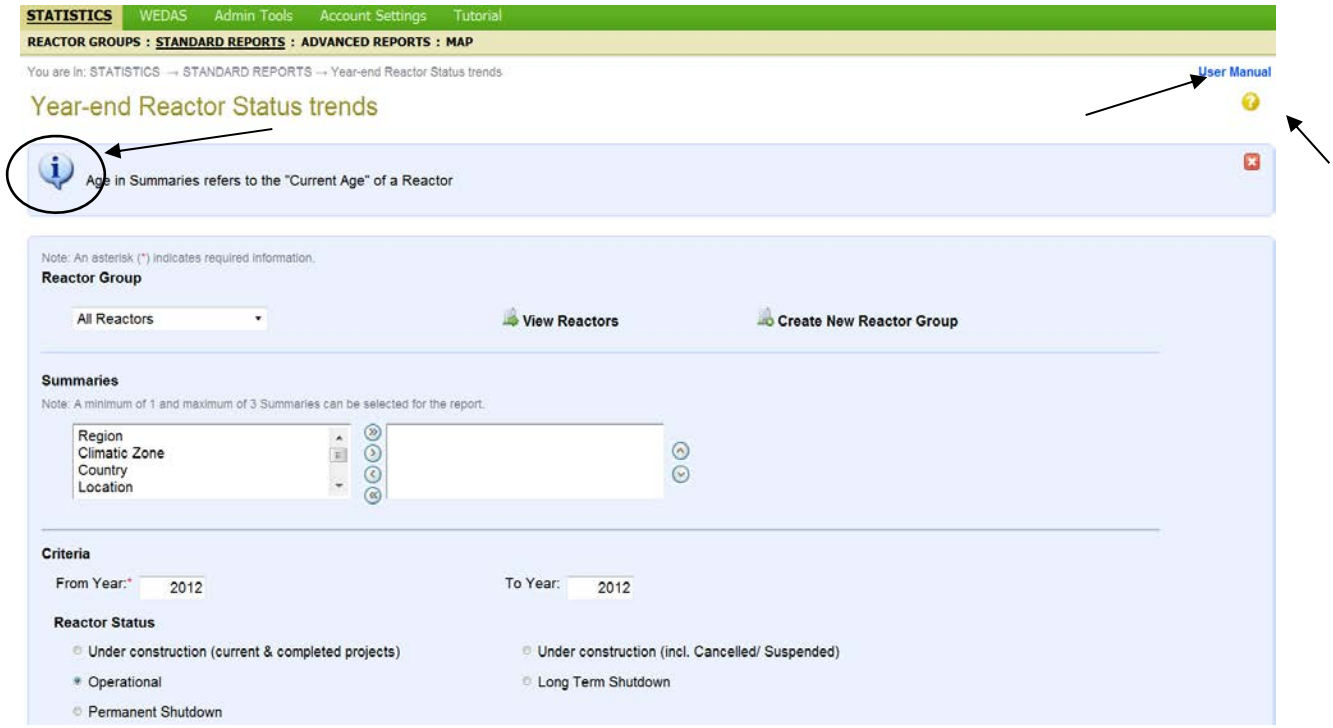


FIG. 2-1. Example of a report interface

If necessary, additional information or instruction will appear between the title of the report and the parameterisation page. The icon appears at the top left hand corner of the margin. It is important that the user read this message, as it will give the relevant information before starting the parametrization of the required report. In some reports there is a warning (!) message to provide important information before running the report.

To get more detailed guidelines for the report it is possible to use the function User Manual on the top right hand corner of the margin. This function provides the entire User Manual of PRIS-Statistics in a new window. The report specific guidelines can be opened by clicking on the icon .

Reactor group :

User can select one of the predefined group of reactors. (See "3 Reactor Groups"). Also View Reactors will confirm the group selected, or choose Create New Reactor Group directly from this parametrization page.

If any group is assigned as a default group, it is predefined for the report. If not, the standard choice "All reactors" is predefined.

Summaries:

In most reports it is possible to summarise results into sub-levels. Summaries should be selected from the left box and transferred to the right box. When any of the summaries are selected, the report provides results for the group and for specific reactors (if this choice is available).

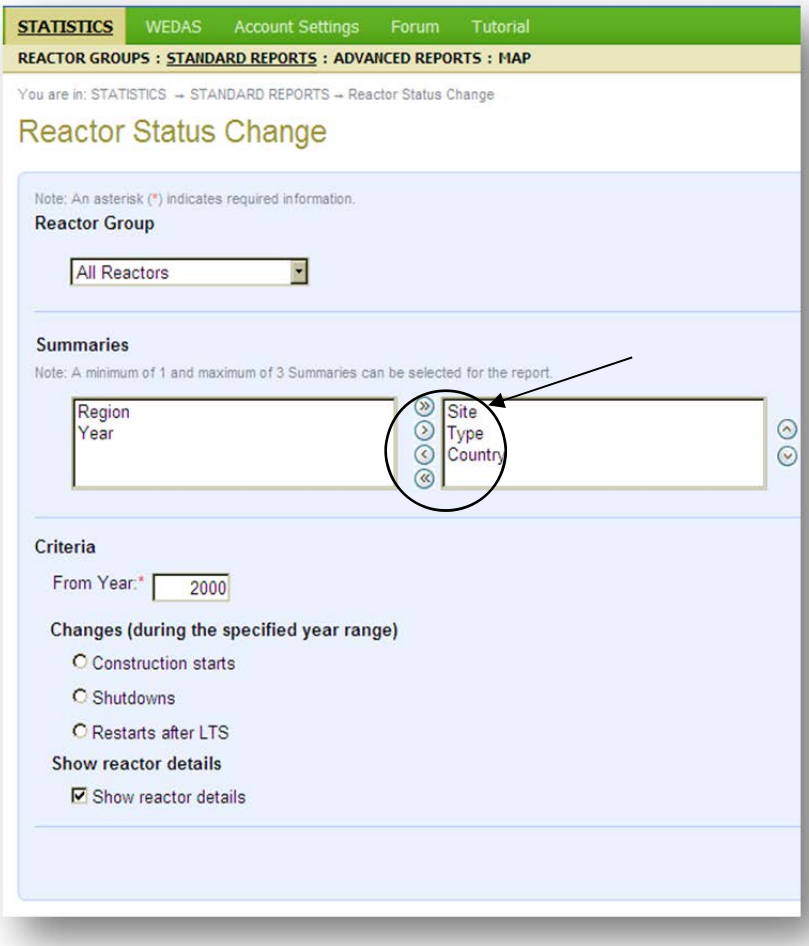


FIG. 2-2. Selection of Summaries.

Up to three Summaries can be selected. This enables aggregation of data in the report in sections (one summary level), sub-sections (two and three summary levels). The rank of the parameters selected will define the level of sectioning. The upper parameter will be the highest section level.

To select a summary, click on the parameter and on the button.

If several summaries are selected, rank can still be organized by clicking on the (move up) or (move down) buttons.

Criteria:

Most of reports are annual reports; therefore, annual period specification is required. When the report reflects the end of a particular year, the base year should be specified.

If the desired report is within a period, it should be specified by From/To Years. The system allows the user to fill only the "From Year" and leave the "To Year" blank assuming that the report covers for only one year.

The “Show Reactor Details” checkbox (if available) provides the possibility to enable or disable reactor specific data within the summaries breakdown. Ifthe box is not checked,the report returns the aggregated data in accordance with the summaries chosen without the reactor details.

The Planned Reactor report does not work with a year range, as the report only provides a list of reactors currently registered in PRIS as planned.

Other filters and selections:

Other criteria specific to the selected report can be offered. Specifically, “Trends” in the “Operational Data” category offers the possibility to generate a histogram for a chosen performance indicator (as shown below, EAF as the example) with a choice of comparative statistics within a reactor group (Median, Weighted Average or Best Quartile). A comprehensive list of filters is used for outage related reports.

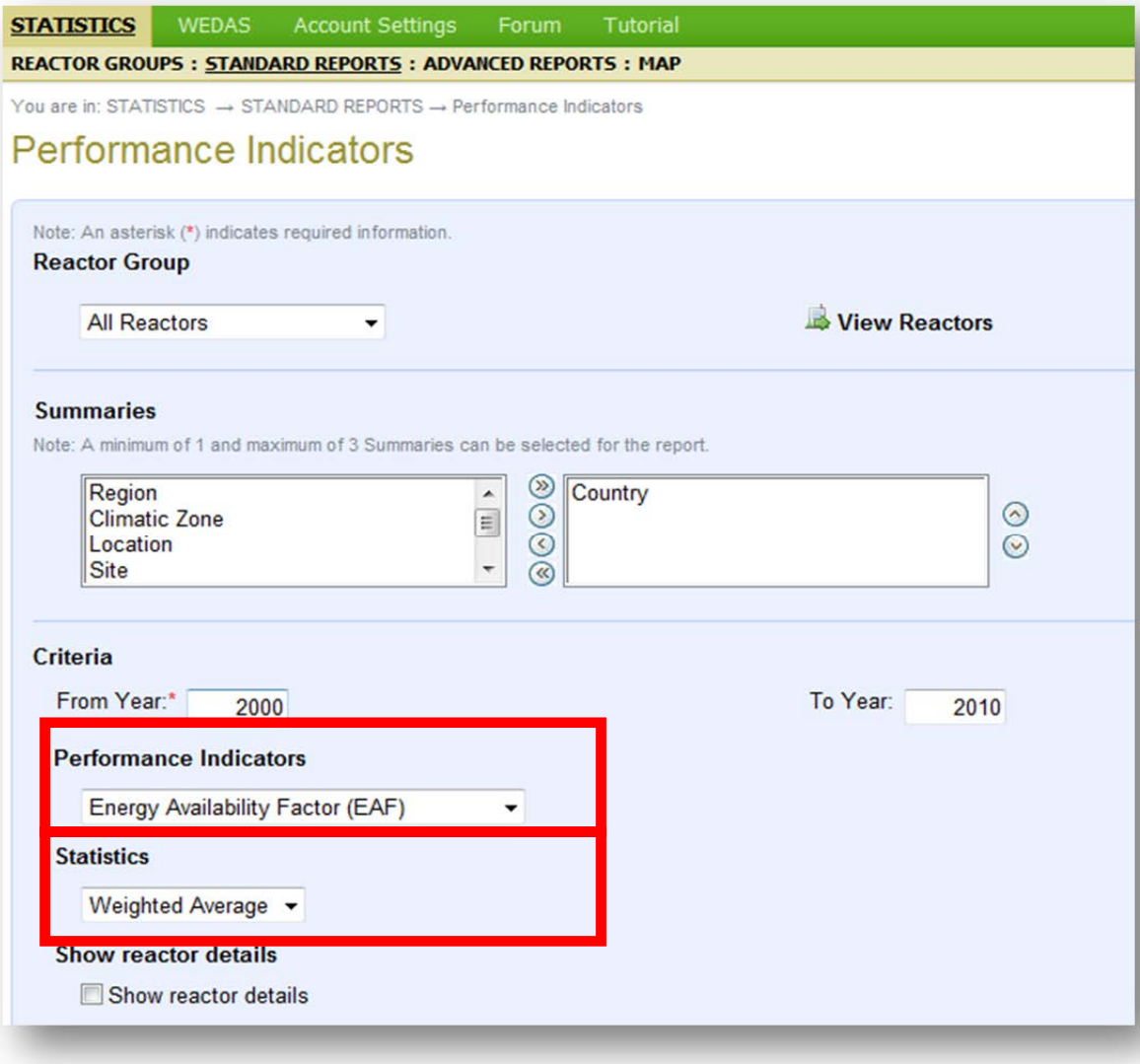


FIG. 2-3. Example of report criteria, filters, parameters and selections.

The “Worldwide Statistics” reports have a very simplified criteria. Those reports do not work with reactors groups (applied to all reactors), summaries and filters. The only parameter that should be specified is a year. Tables offer data with comprehensive information relative to the selected report type, for a defined year, for all worldwide reactors. These tables are compatible with the tables in the annual publication “Nuclear Power Reactors in the World”.

2.3. Report Functions

All reports provide ZOOM, FIND, PRINT and EXPORT functions.

ZOOM function allows display control of the generated report.

PRINT function provides a user friendly printout of a report.

EXPORT function allows exporting of generated report into the following formats:

- Acrobat (PDF)
- Web Archive (HTML)
- Excel (XLS)

Select one of the three options from the drop-down menu and select “Export”. The report is transferred into the desired format and opened in the desired application. The report can be saved in this format and customized further in Excel.

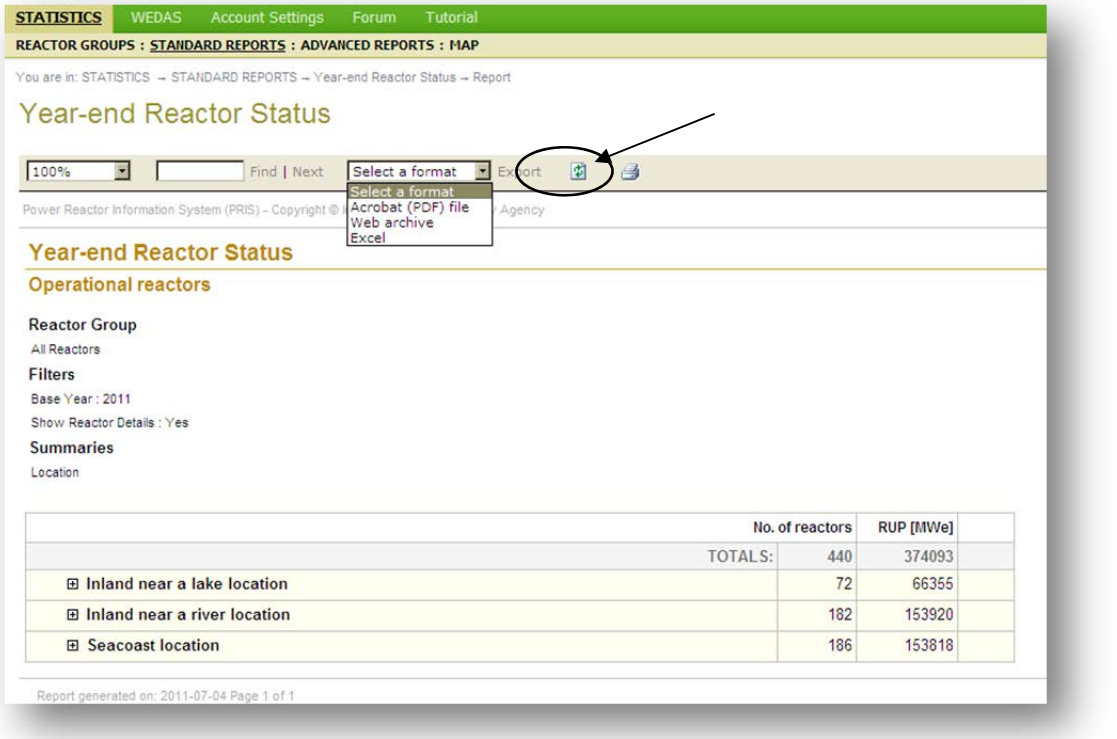


FIG. 2-4. Report EXPORT function.

2.4. General Rules and Methods Used in Reports

Report specific conditions are described in each particular report guidelines. This section refers to general conditions allied mainly to the performance indicator (PI) reports.

2.4.1. Criteria for Data Selection for PI Reports

Except for the scram rates (UA7 and US7) and LFH, which includes annual non-electrical applications data, the performance indicators are calculated from monthly records. The records are filtered to only include those months during which a reactor was in commercial operation, i.e. the period from the reactor's commercial date to its permanent shutdown date, excluding periods of long-term shutdown.

The 15 day condition is applied to decide whether 'borderline' months, i.e. the months of the commercial date, the long-term shutdown date, the restart date and the permanent shutdown date, should be included in the calculation. The 'borderline' month is included when the reactor was in commercial operation at least 15 days in the month. For instance: when 'Commercial date' is 25 April the data for April are not included in the calculation.

Reactors that were not operational for at least one month during the reporting period are automatically excluded from the report.

In early years, there were gaps in production data. A criterion to determine whether data are sufficient for selection and PI result calculation is the so-called "50% criterion". Data are considered sufficient if there are monthly production records for at least half of the required months (during which a reactor was operational) in the reporting period.

When the PI report includes reactors with less than 100% completeness, a column 'Data Completeness' is displayed showing percentage of available data. PI results related to insufficient data are displayed in red as 'not qualified' and are not included in calculation of aggregated values.

2.4.2. Methods Used for Group Statistics

Report statistics are aggregated for a chosen group of reactors (or all reactors) and for selected summary levels.

Aggregated statistics include only results from 'qualified' reactors. Qualified reactors are those reactors which performance data meets 50% criterion. When the number of qualified reactors is less than the number of operated reactors, an extra column with number of qualified reactors is shown in PI reports.

PRISTA reports contain the following statistics:

- Weighted average;
- Median;
- Best quartile;
- Maximum/minimum;
- Standard deviation.

A weighted average in PRIS is not calculated from individual PI results but as a group value. Raw data from individual reactors are summarized and then the calculating formula is applied.

For example, Load Factor for individual reactor (i) is defined as:

$$LF(i) = \frac{EG(i)}{REG(i)} \times 100$$

Where EG(i) is electricity generated for the period and REG(i) is reference energy generated for the period (capacity multiplied by hours in the period) of an individual (i) reactor.

The weighted average in PRIS is calculated as:

$$LF = \frac{\sum EG(i)}{\sum REG(i)} \times 100$$

When all reactors from reported groups are operated during the entire selected period, the PRIS weighted average is equivalent to:

- Weighted average of individual PI results where weight is a reactor capacity – this applies to performance indicators where REG is used as a denominator.
- Weighted average of individual PI results where weight is a number of critical hours – this applies to scram rate factors.

When operating time of individual reactors is different, the time in operation is an additional weight in the PRIS weighted average.

Calculation of the median (centred value) is done on individual PI results using a standard statistical function.

The quartile is also calculated using individual PI results. Contrary to the median, there are different methods for quartile calculation. In PRIS, the Minitab method is used. The same method is used by WANO. MS Excel, on the other hand, uses a 'Freund and Perles' method. This can cause minor differences when the best quartile is recalculated for exportation to Excel.

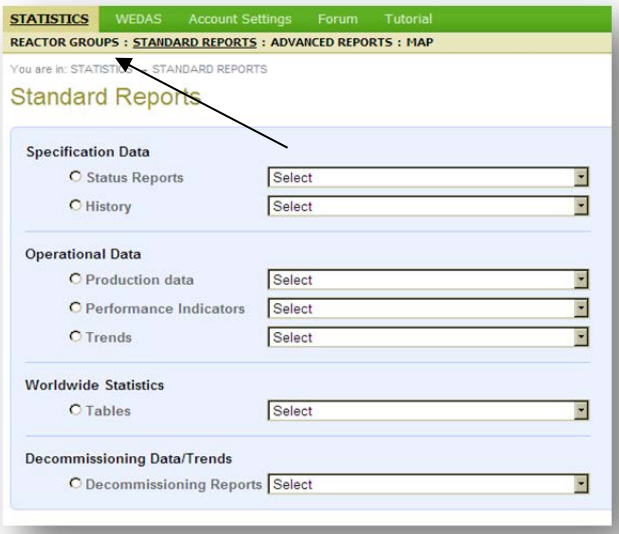
Maximum and minimum values are simply selections from individual PI results.

3. REACTOR GROUPS

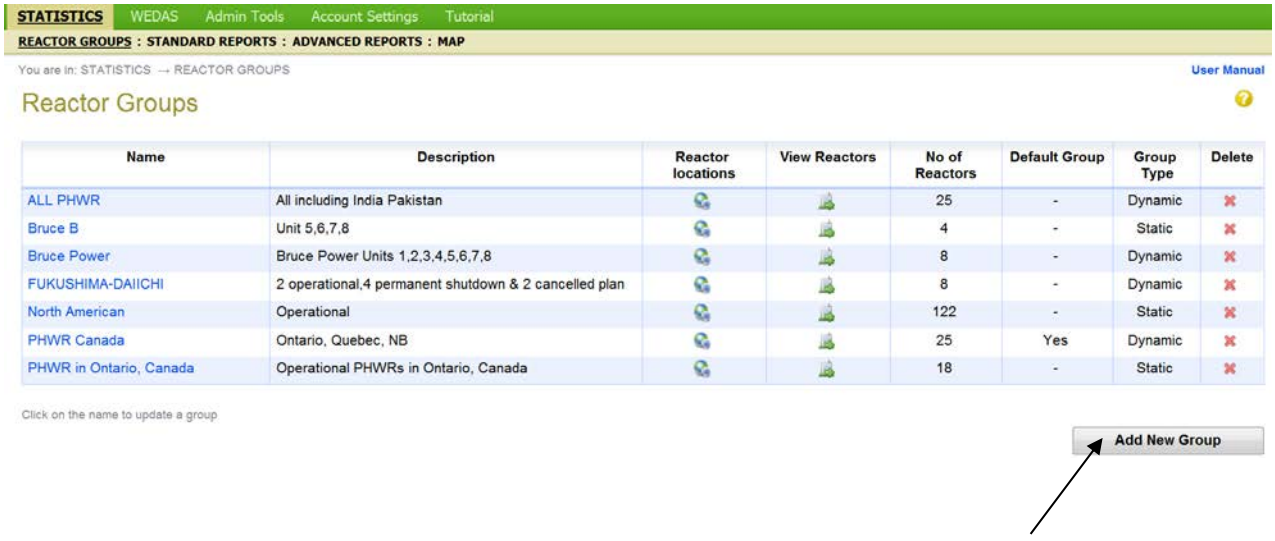
Managing reactor groups allows users to build groups of reactors which suit reporting needs. The system allows a user to create an unlimited number of predefined groups which are assigned only to the user who created the group.

When a group is created, it can be used for any report in the system. For instance, to group all reactors that are in a specific country or all reactors with the same design characteristics, the following will aid in creation of these groupings:

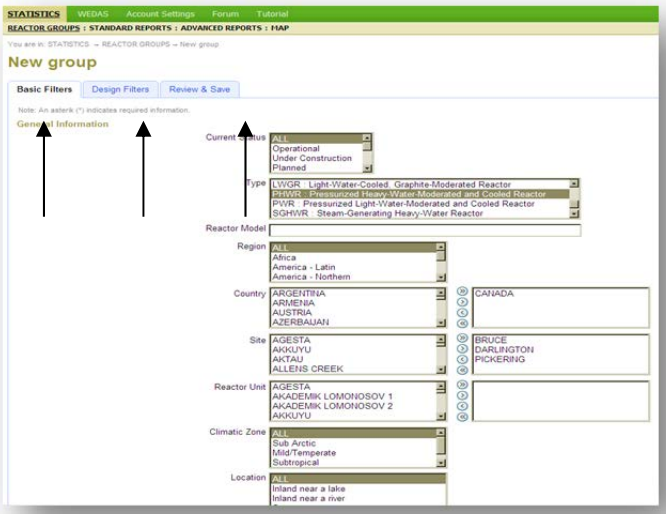
1. Select "Reactor Groups"



2. Select "Add New Group"

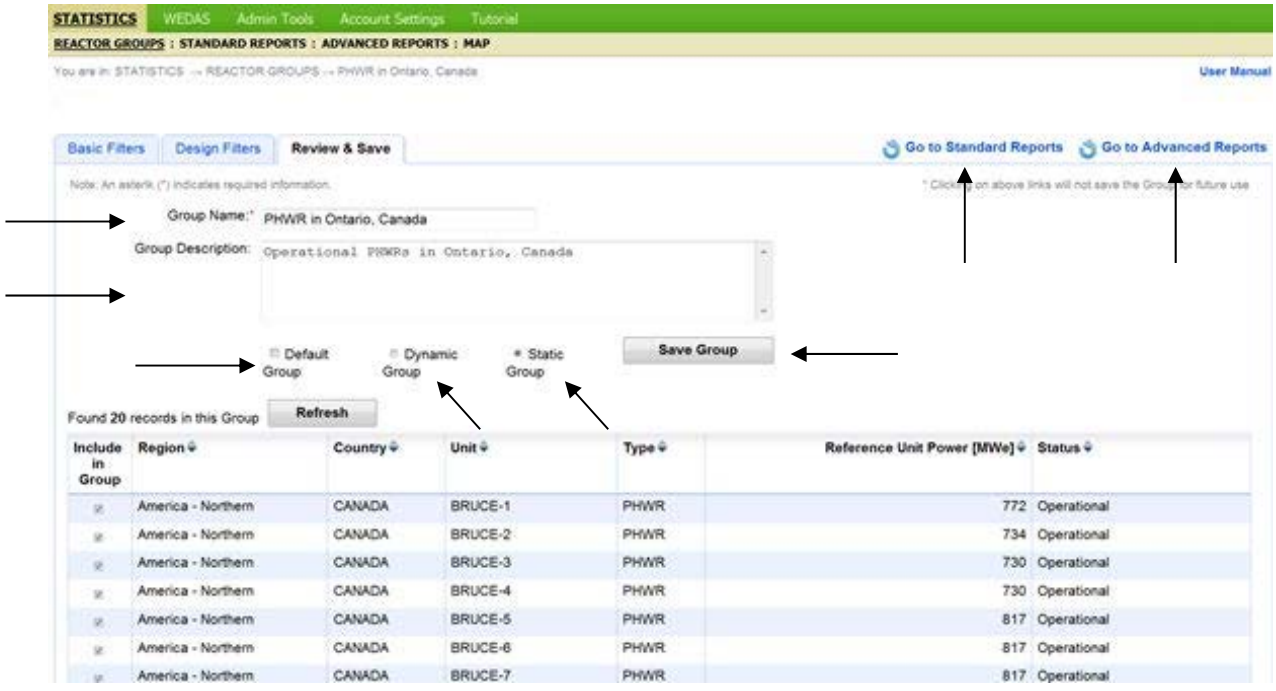


3. Select the required parameters for the desired grouping. There are 2 tabs: "Basic Filters", "Design Filters" for selection criteria. Fill in all the information that is required for the grouping. For more details about Design Characteristics, see Ref. [3].



4. “Review & Save” helps to check the results of the chosen selections and filters. It also gives the opportunity to exclude particular reactors from the group. When the list of reactors satisfies all expectations, it can be saved with a specific name (Group Name) and explanation notes placed in the “Group Description” field.

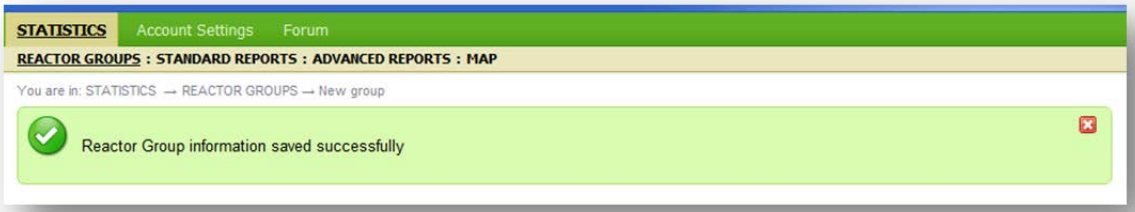
Note: A group could be either “Dynamic” or “Static”. The dynamic group is updated automatically when any of filtering parameter is changed in PRIS. The static group, which allows exclusion of individual reactors from the group, does not reflect any later changes in filtering parameters. Nevertheless the static group can be refreshed manually using the “Refresh” button.



The system allows to select one group as a default group. The default group is the preselected choice in report interface setting. To assign the group as a default, check the “Default Group” box.

The system allows using the selected reactor group without its saving. When the list of reactors is agreed it is possible to go directly to standard or advanced reports and generate them for the unsaved group.

5. If the grouping saved successfully, it will receive a checkmark. If no checkmark is received, more information is needed for the grouping.



6. Go back to “Reactor Groups” to view the new group created.

For each group there are two reports available:

— “Reactor locations” shows all reactors from the group on a map
— “View Reactors” provides sorting ability for the lists of reactors from the group including icons for dashboard (for operational reactors only) basic information, design characteristics and schematics.

Using Reactor Groups is essential for plant performance analyses and benchmarking. Selection of relevant reactors into a group assures that reports compare pertinent information.

4. STANDARD REPORTS

This chapter provides detailed information about the individual PRIS-Statistics reports. Each report is introduced via a high-level description explaining the purpose of the report. Second, the concept behind each report is explained in detail and the parameters to be provided by the user are described. Third, the conditions applied to the PRIS data for calculating the statistics presented in the report are explained. The condition section is relevant to advanced users who want to know how certain numbers are calculated. Moreover, understanding these conditions allows the user to understand differences between reports. Finally, the data sources for each report are outlined.

The structure of this chapter follows the menu structure in PRISTA.

4.1. Specification Data

4.1.1. Status Report – Year-End Reactor Status

This report provides an overview of reactors in a selected life cycle status – from construction through operation to permanent shutdown.

Year-end Reactor Status

Operational reactors

Reactor Group
All Reactors

Filters
Base Year : 2011
Show Reactor Details : Yes

Summaries
Region, Country, Type

	No. of reactors	RUP [MWe]
TOTALS:	433	366442
Africa	2	1800
America - Latin	6	4119
America - Northern	122	113809
Asia - Far East	92	78860
Asia - Middle East and South	24	6031
Europe - Central and Eastern	67	47452
Europe - Western	120	114371
BELGIUM	7	5927
FINLAND	4	2716
FRANCE	58	63130
GERMANY	9	12068
NETHERLANDS	1	482
SPAIN	8	7567
SWEDEN	10	9298
BWR	7	6503

ISO Code	Unit	Current Stat	Type	Model	Operator	Reactor Suppli	Const. Date	Grid Date	RUP [MWe]	More De
SE	FORSMARK-1	Operational	BWR	BWR 75	FKA	ABBATOM	1973-06-01	1980-06-06	978	B D S
SE	FORSMARK-2	Operational	BWR	BWR 75	FKA	ABBATOM	1975-01-01	1981-01-26	990	B D S
SE	FORSMARK-3	Operational	BWR	BWR 3000	FKA	ABBATOM	1979-01-01	1985-03-05	1170	B D S
SE	OSKARSHAMN-1	Operational	BWR	ABB BWR	OKG	ABBATOM	1966-08-01	1971-08-19	473	B D S
SE	OSKARSHAMN-2	Operational	BWR	ABB BWR	OKG	ABBATOM	1969-09-01	1974-10-02	638	B D S
SE	OSKARSHAMN-3	Operational	BWR	BWR 75	OKG	ABBATOM	1980-05-01	1985-03-03	1400	B D S
SE	RINGHALS-1	Operational	BWR	BWR	RAB	ABBATOM	1969-02-01	1974-10-14	854	B D S

PWR	3	2795
SWITZERLAND	5	3263
UNITED KINGDOM	18	9920

FIG. 4-1. Example of the Year-end Reactor Status Report.

Concept:

- The report provides information about all reactors in a given status in a year selected by the user.
- The report has two mandatory parameters: the base year for which the report shall be generated and one or more reactor status to be considered.
- The report can be generated for the current year and for historical years. By default, the current year is selected as a base year.
- The user must select at least one reactor status to be included in the report. By default, the status "operational" is selected.
- For reactors under construction, there are two options:
    - "Under construction (current and completed projects)" includes all reactors that were under construction in the base year, excluding projects that were eventually suspended or cancelled;
    - "Under construction (including cancelled/suspended)" includes all projects that were under construction in the base year, regardless of whether they were eventually completed or not.
- Optionally, an age filter can be applied (to reactors in operation, in long-term shutdown or in permanent shutdown), so that only reactors that were of a certain age in the base year are considered.
- Up to three levels of grouping (Region, Country, Location, Site, Type, and Age) can be applied to the result set. A reactor can only appear in exactly one group in the result set.
- The Show *Reactor Details* option returns specification data about individual reactors in addition to summary-level results. Detailed information about each reactor includes basic design information (e.g. type, model, RUP, etc.) as well as links to the *Basic Information*, *Design Characteristics* and *Schematics* reports.

Condition:

- For historical years, the report reflects reactor status and reference unit power (RUP) *at the end* of the base year. In the current year, the latest situation is reflected.
- Reactors that were in a given status during the year but changed status before the end of that year are not included in the report.
- For reactors under construction, the design net electrical capacity is used as RUP.
- For reactors in long-term shutdown, RUP is the net electrical capacity in the month preceding the long-term shutdown.
- For reactors in permanent shutdown, RUP is the last-known net electrical capacity at the point in time the reactor was shut down.

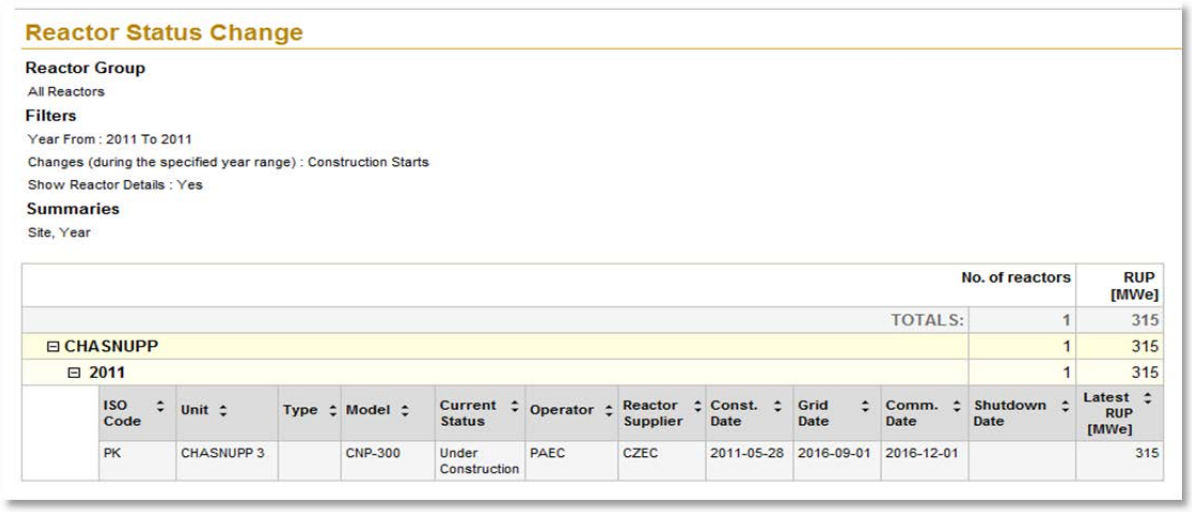
Data Selection:

- Reactor detail information is selected from the Reactor table of the PRIS database.
- For reactors that have reached the "operational" status, RUP is selected from monthly production data to reflect RUP revisions. The closest available match from the Annual Electricity Reconstruction table is used. For planned reactors and reactors under construction (including cancelled and suspended projects), design net electrical capacity from the Reactor table is used.
- When "age" is used as a filter or summary criterion, it means the age of a reactor at the end of selected year.

– As PRIS does not store historical status information about reactors, the status of a reactor in a given year is determined from its current status as well as milestone dates available in the Reactor table.

4.1.2. Status Reports – Reactor Status Change Report

This report provides an overview of reactors status changes during a given year. The status changes considered by the report are construction starts, grid connections, permanent shutdowns, long-term shutdowns and restarts after a long-term shutdown.



Reactor Status Change

Reactor Group
All Reactors
Filters
Year From : 2011 To 2011
Changes (during the specified year range) : Construction Starts
Show Reactor Details : Yes
Summaries
Site, Year

	No. of reactors	RUP [MWe]
TOTALS:	1	315
⊟ CHASNUPP	1	315
⊟ 2011	1	315

ISO Code	Unit	Type	Model	Current Status	Operator	Reactor Supplier	Const. Date	Grid Date	Comm. Date	Shutdown Date	Latest RUP [MWe]
PK	CHASNUPP 3		CNP-300	Under Construction	PAEC	CZEC	2011-05-28	2016-09-01	2016-12-01		315

FIG. 4-2. Example of the Status Change Report.

Concept:

– The report provides the number of reactors and total net electrical capacity of all reactors within the selected type of status change in the reporting period.
– The report can be generated for historical periods up to and including the current year. By default, the report is generated for the current year.
– If the user only enters a "from" year and leaves the "to" year of the reporting period blank, the report is generated for one year, i.e. the "from" year.
– Only one type of status change can be selected by the user (construction starts, grid connections, permanent shutdowns, long-term shutdowns and restarts after a long-term shutdown)
– Up to three levels of grouping (Region, Country, Site, Type, and Year) can be applied to the result set. A reactor can only appear in exactly one group.
– The *Show Reactor Details* option returns specification data about individual reactors in addition to summary-level results. Detailed information about each reactor includes basic design information (e.g. type, model, RUP, etc.) as well as links to the *Basic Information*, *Design Characteristics* and *Schematics* reports.

Condition:

– The Reference Unit Power (RUP) is calculated in the following way:

- For construction starts and grid connections: design net electrical capacity is used. If the design capacity is unavailable (0), the latest net electrical capacity from the Reactor table is used.
- For permanent shutdowns: the latest net electrical capacity from the reactor table is used. If the latest capacity is unavailable (0), the design net electrical capacity is used.
- For long-term shutdowns and restarts: the last known net electrical capacity before the long-term shutdown from the Annual Electricity Reconstruction table is used.

Data Selection:

– Reactor detail information is from the Reactor table of the PRIS database.
– The report determines the date of a status change based on:
  - The reactor's current status;
  - The relevant dates in the Reactor table (construction date, grid date, shutdown date);
  - Information on long-term shutdowns (Long-term Shutdown Details table).

4.1.3. Status Report – Planned Reactors

This report lists all reactors that are currently reported as "planned" for construction.

Planned Reactors

Reactor Group
All Reactors
Filters
Show Reactor Details : Yes
Summaries
Country
List of planned reactors contains current projects officially reported to the IAEA by Member States.

	No. of reactors	RUP [MWe]
TOTALS:	121	117830
⊞ CHINA	42	34786
⊞ INDIA	2	1400
⊞ IRAN, ISLAMIC REPUBLIC OF	3	2160
⊞ JAPAN	10	7568
⊞ KOREA, REPUBLIC OF	2	2680
⊞ PAKISTAN	1	315
⊞ RUSSIAN FEDERATION	37	38963
⊞ UNITED STATES OF AMERICA	22	27958
⊞ VIET NAM	2	2000

FIG. 4-3. Example of the Planned Reactor Report.

Concept:

– The report can only be generated for the current year.
– The report calculates the total net electrical capacity and the number of the reactors included in the report.
– Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, and Type) may be applied to the result set. A reactor can only appear in exactly one group in the result set.

– The Show Reactor Details option returns specification data about individual reactors in addition to summary level results. Detailed information about each reactor includes basic design information (e.g. type, model, operator, RUP, etc.) as well as key milestone dates (construction date, commercial date, shutdown date).

Condition:

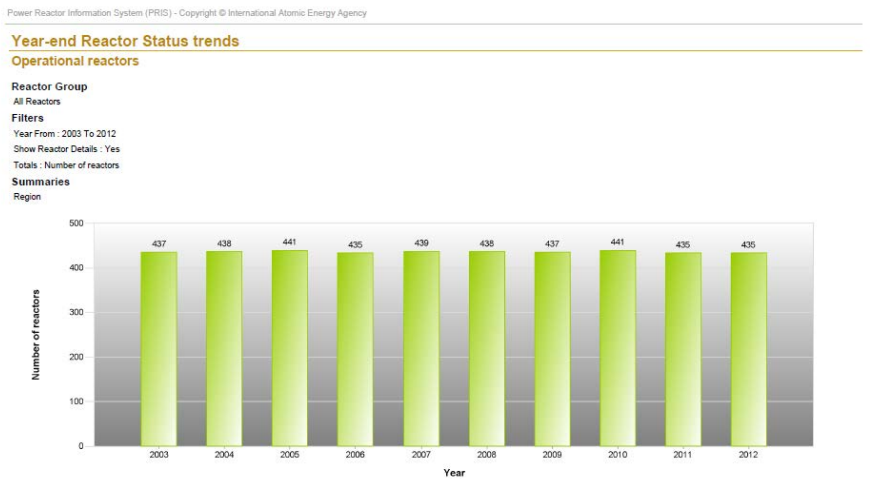
– Design net capacity is used as RUP.

Data Selection:

– Reactor detail information is selected from the Reactor table.
– The report uses the same selection criteria as the Year-End Reactor Status report. The "base date" uses all reactors in "planned" status up to 31 December of the current year.

4.1.4. History – Year-end Reactor Status Trends

This report displays the historical evolution of either *the number* of reactors in a selected status or their *total net electrical capacity*. Yearly totals are displayed as a bar chart and as a data table.



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	Number of reactors									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TOTALS:	437	438	441	435	439	438	437	441	435	435
Africa	2	2	2	2	2	2	2	2	2	2
America - Latin	6	6	6	6	6	6	6	6	6	6
Unit	RUP [MW]	RUP [MW]	RUP [MW]	RUP [MW]	RUP [MW]	RUP [MW]	RUP [MW]	RUP [MW]	RUP [MW]	RUP [MW]
ANGRA-1	626	626	626	626	520	491	609	609	609	609
ANGRA-2	1275	1275	1275	1275	1275	1275	1275	1275	1275	1275
ATUCHA-1	335	335	335	335	335	335	335	335	335	335
EMBALSE	600	600	600	600	600	600	600	600	600	600
LAGUNA VERDE-1	680	680	680	680	680	650	650	650	650	650
LAGUNA VERDE-2	680	680	680	680	680	650	650	650	650	650
America - Northern	119	120	121	121	122	122	122	122	122	122
Asia - Far East	85	87	90	91	92	92	91	94	93	93
Asia - Middle East and South	16	16	17	18	19	19	20	21	24	24
Europe - Central and Eastern	68	70	70	67	68	67	66	67	68	68
Europe - Western	141	137	135	130	130	130	130	129	120	120

FIG. 4-4. Example of the Year-end Reactor Status Trend Change Report.

Concept:

- The report can be generated for historical periods up to and including the current year. By default, the report is generated for the current year.
- If the user enters a "from" year and leaves the "to" year of the reporting period blank, the report is generated for one year, i.e. the "from" year.
- The user has to select one reactor status as a filter. Only reactors that were in the chosen status for at least one year during the reporting period are included in the report. The default selection is the status "Operational".
- For reactors under construction, there are two options.
    - "Under construction (current & completed projects)" includes all reactors that were under construction in the base year, excluding projects that were eventually suspended or cancelled.
    - "Under construction (incl. Cancelled/Suspended) includes all projects that were under construction in the base year, regardless of whether they were eventually completed or not.
- Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, and Age) may be applied to the result set. A reactor can only appear in one group in the result set.
- The user has the choice of three summary options:
    - Number of reactors: the bar chart illustrates the total number of reactors in the chosen status for each year in the reporting period. Summary level information in the data table includes the number of reactors for each group, for each year.
    - Net electrical capacity: the bar chart illustrates the total net electrical capacity of reactor units (MWe) in the chosen status for each year in the reporting period. Summary level information in the data table includes the total net electrical capacity of reactor units for each group, for each year.
    - Number of reactors and net electrical capacity: the bar chart illustrates the total number of reactors in the chosen status for each year in the reporting period. Summary level information in the data table includes the number of reactors and the total net electrical capacity for each group, for each year.
- The Show *Reactor Details* option includes reactor level information in addition to summary level results. Detailed information includes the name and net electrical capacity of each reactor unit in the reporting period.

Condition:

- A maximum of 20 years can be specified for the reporting period.
- The report reflects reactor status and Reference Unit Power (RUP) at the end of each year for historical years. For the current year, it reflects the latest situation.
- Data is only provided for those years, in which a reactor was in the selected status at the end of the year. For all other years in the report, reactor level information is left blank and the reactor is not counted in yearly totals.
- When age is selected in summaries, the *current* age of the reactor is applied in the report.

Data Selection:

- Reactor detail information is from Reactor and Site tables of the PRIS database.
- For operational reactors, RUP is selected from monthly production data to reflect RUP revisions. The closest available match from the Annual Electricity Reconstruction table is used for that purpose.

– For reactors under construction (including cancelled and suspended projects), design net electrical capacity from the Reactor table is used.
– For reactors in long-term shutdown, the last net electrical capacity before the shutdown is used for all reporting years.
– For permanently shut down reactors, the last net capacity before the shutdown is used as RUP for all reporting years.

4.2. Operational Data

4.2.1. Production Data – Electricity Supplied

This report calculates the total *amount of electricity supplied to the grid* (in gigawatt-hours) by all reactor units that were operational during the reporting period.

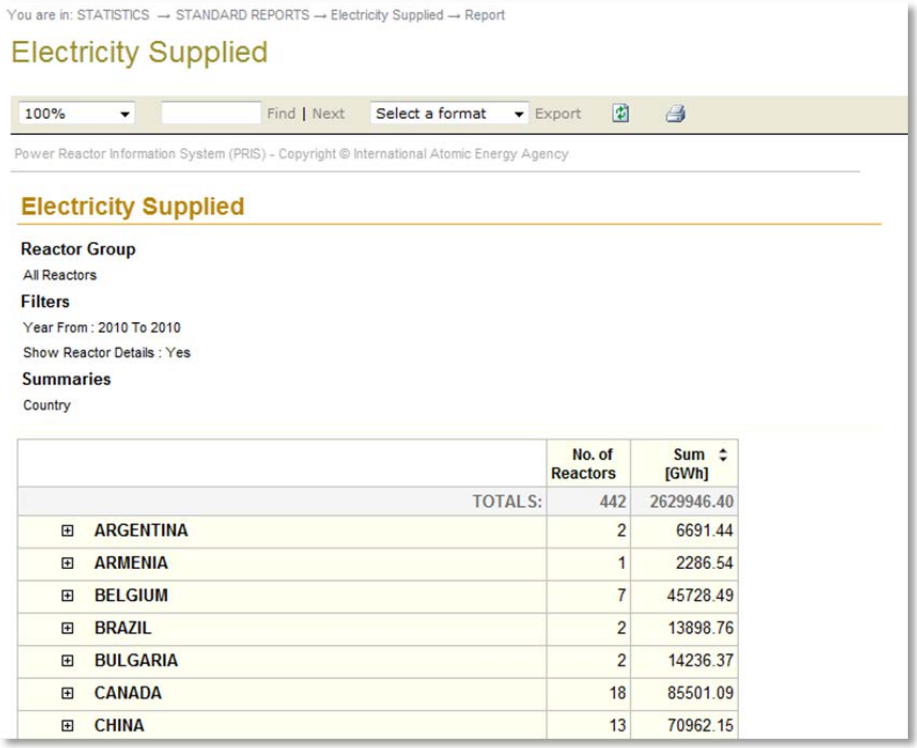


FIG. 4-5. Example of the Electricity Supplied Report.

Concept:

– The report provides the sum of electricity supplied (net generation) for all reactor units that were operational during the reporting period chosen by the user.
– The report can be generated for historical periods up to and including the current year. By default, the report is generated for the previous year.
– If the user only enters a "from" year and leaves the "to" year of the reporting period blank, the report is generated for one year, i.e. the "from" year.
– Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, Age, and Year) may be applied to the result set. When grouping by year or age, a reactor may appear in several/all groups of the result set.
– The Show Reactor *Details* option includes reactor level information in addition to summary level results. Detailed information includes the name, type, model and net

electrical capacity of each reactor unit in addition to the electricity supplied throughout the reporting period.

Condition:

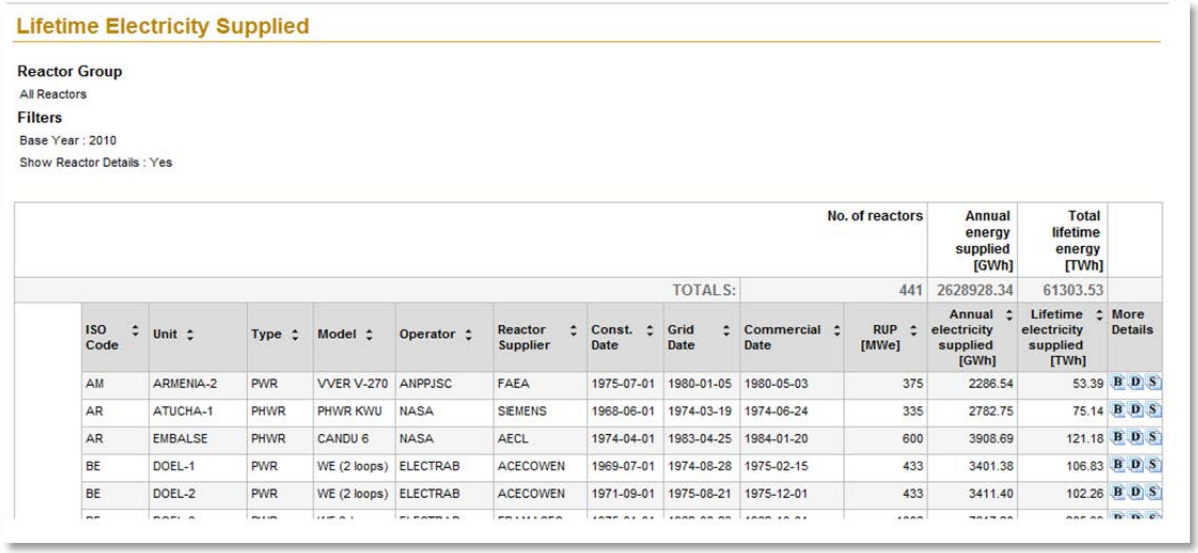
- Only reactors that were operational for at least one month during the reporting period are included in the report.
- Electricity supplied is calculated for the period between the reactor's grid connection (including trial operation) and its permanent shutdown, excluding periods of long-term shutdown.
- When data are not complete for a reporting period a 'Data Completeness' indicator by percentage is shown. The percentage value is calculated as the number of months for which data is available in relation to the number of months during which a given reactor was operational during the reporting period. Therefore, completeness of less than 100% indicates that the total electricity supplied during the reporting period is likely to be higher but that data collection is still incomplete.
- RUP of individual reactor units is the RUP at the end of the reporting period
- When the report is grouped by age instead of year, the age of each reactor is calculated from the end of the reporting period.
- When the report is grouped by age and year in combination, the age of each reactor is calculated for each reporting year. Therefore, reactors are likely to appear in several age/year groups.

Data Selection:

- Reactor detail information is from the Reactor and Site tables of the PRIS database.
- The calculation of electricity supplied is based on monthly production records between a reactor's grid date and its shutdown date, excluding periods of long-term shutdown. Reactors that were not operational during at least one month during the reporting period are excluded from the report.
- When calculating summaries (i.e. when grouping is selected), the electricity supplied by all reactor unit s within a group is considered independently of the data completeness. Data completeness for each group is calculated on a monthly basis *and not* as an average of the reactor level values.

4.2.2. Production Data - Lifetime Electricity Supplied

This report calculates the *lifetime electricity supplied* (in Terawatt-Hours) for all reactor units that were operational in the reporting year. Lifetime electricity supplied is defined as the total amount of electricity supplied by a reactor unit from its first grid connection to its permanent shutdown, excluding periods of long-term shutdown.



Lifetime Electricity Supplied

Reactor Group

All Reactors

Filters

Base Year : 2010

Show Reactor Details : Yes

										No. of reactors	Annual energy supplied [GWh]	Total lifetime energy [TWh]	
									TOTALS:	441	2628928.34	61303.53	
	ISO Code	Unit	Type	Model	Operator	Reactor Supplier	Const. Date	Grid Date	Commercial Date	RUP [MWe]	Annual electricity supplied [GWh]	Lifetime electricity supplied [TWh]	More Details
	AM	ARMENIA-2	PWR	VVER V-270	ANPPJSC	FAEA	1975-07-01	1980-01-05	1980-05-03	375	2286.54	53.39	B D S
	AR	ATUCHA-1	PHWR	PHWR KWU	NASA	SIEMENS	1968-06-01	1974-03-19	1974-06-24	335	2782.75	75.14	B D S
	AR	EMBALSE	PHWR	CANDU 6	NASA	AECL	1974-04-01	1983-04-25	1984-01-20	600	3908.69	121.18	B D S
	BE	DOEL-1	PWR	WE (2 loops)	ELECTRAB	ACECOWEN	1969-07-01	1974-08-28	1975-02-15	433	3401.38	106.83	B D S
	BE	DOEL-2	PWR	WE (2 loops)	ELECTRAB	ACECOWEN	1971-09-01	1975-08-21	1975-12-01	433	3411.40	102.26	B D S

FIG. 4-6. Example of the Lifetime Electricity Supplied Report.

Concept:

- The report has only one mandatory parameter: the base year for which the report is generated.
- The report can be generated for the current year and for historical years. By default, the current year is selected.
- Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, and Age) can be applied to the result set. A reactor can only appear in one group of the result set.
- The Show Reactor Details option returns specification data about individual reactors in addition to summary level results. Detailed information about each reactor includes basic design information (e.g. type, model, RUP, etc.) as well as links to the *Basic Information*, *Design Characteristics* and *Schematics* reports.

Condition:

- For each reactor, as well as for group and report level totals, the report calculates the amount of electricity supplied in the reporting year ("annual electricity supplied")
- For each reactor included in the report, as well as for group and report level totals, the report calculates the total amount of electricity supplied during the reactor's lifetime up to the end of the reporting year ("lifetime electricity supplied")
- If data collection for the reporting year is incomplete, "DI" (= "data insufficient") is displayed instead of the annual electricity production value. The rule applied to determine whether data is sufficient is the "50% criterion". Data is considered sufficient if there are monthly production records for at least half of the months during which a reactor was operational during the reporting year.
- RUP for individual reactor units is the RUP at the end of the base year.

Data Selection:

- Lifetime and annual electricity supplied are selected from the Annual Production table.
- RUP is calculated following the same logic as the Year-end Reactor Status report.

4.2.3. Production Data – Reactor Dashboards

This report is highly informative, combining specification and production data about a particular reactor on a single page. The following data are included in the dashboard:

- Unit picture (right upper corner).
- Basic information:
  - Reactor type and model;
  - Latest thermal, gross and net electrical power (RUP) in MW(e);
  - Design net electrical capacity in MW(e);
  - Key lifecycle dates (construction date, grid connection, commercial date).
- Design Characteristics (selected characteristics).
- Operating History.
- Performance indicators for 10 years and lifetime.
- Energy Availability Trends for the reactor in relation to the world median and top quartile (chart).
- Causes of grid disconnection in the past 5 years (pie chart; distribution of causes by full outage duration).

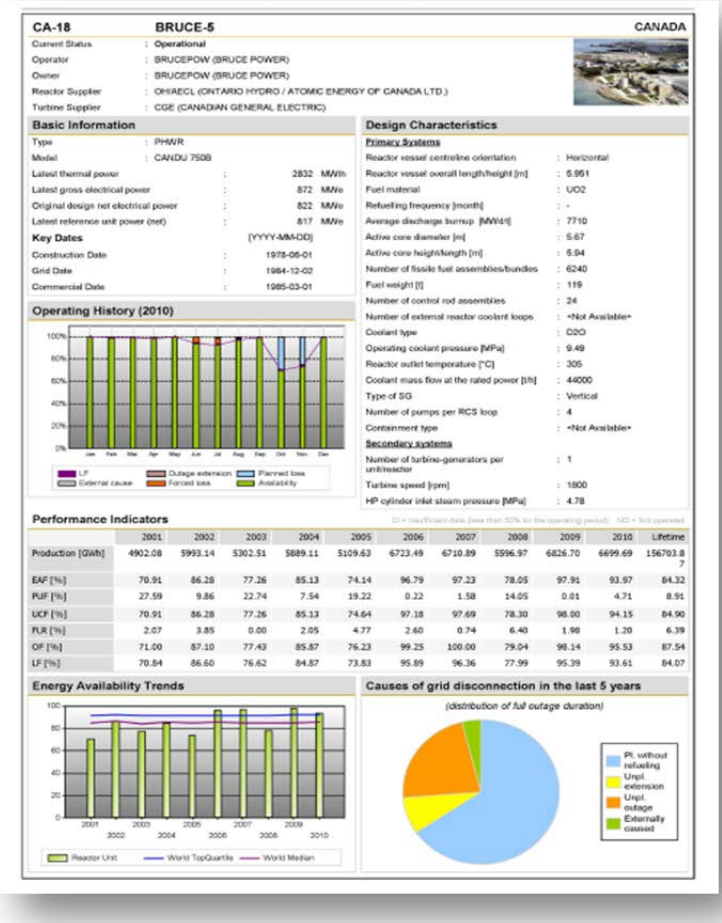


FIG. 4-7. Example of the Dashboard Report.

Concept:

- The report can be generated for any reactor group or for all reactors. However, it is recommended to select a small reactor group in order to avoid long processing time.

– The report provides a one-page summary of PRIS information about each reactor in the selected group.
– The report is only applicable to operational reactors.

Condition:

– The report includes all reactors in the selected group that were operational up until the current year.
– The latest available data are used for the dashboard statistics.

Data Selection:

– Reactor dashboard information is from reactor specification data, design characteristics, monthly production data, outage data and other information extracted from the PRIS database.

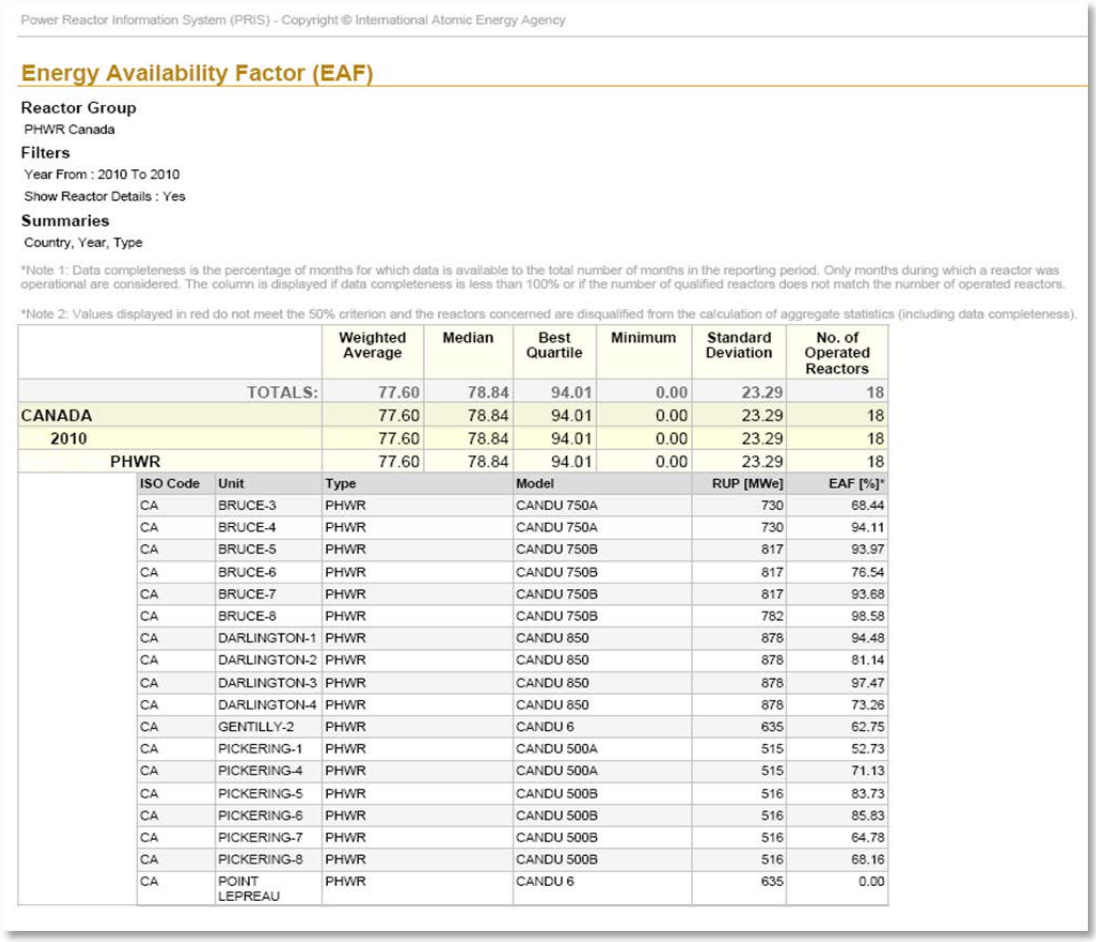
4.2.4. Performance Indicators

The *Performance Indicator* (PI) reports series comprises 13 reports:

– Energy Availability Factor (EAF)
– Energy Unavailability Factor (EUF)
– Planned Unavailability Factor (PUF)
– Unplanned Unavailability Factor (UUF)
– External Unavailability Factor (XUF)
– Unit Capability Factor (UCF)
– Unplanned Capability Loss Factor (UCL)
– Forced Loss Rate (FLR)
– Load Factor (LF)
– Operating Factor (OF)
– Unplanned Automatic Scram Rate (UA7)
– Unplanned Scram Rate (US7)
– Load Factor including Heat (LFH) – Non-electrical applications data

For a selected group of reactors, the report calculates the relevant performance indicator for a period of one or several consecutive calendar years.

Detailed definitions of the performance indicators are provided in the PRIS Ref. [1].



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Energy Availability Factor (EAF)

Reactor Group

PHWR Canada

Filters

Year From : 2010 To 2010

Show Reactor Details : Yes

Summaries

Country, Year, Type

*Note 1: Data completeness is the percentage of months for which data is available to the total number of months in the reporting period. Only months during which a reactor was operational are considered. The column is displayed if data completeness is less than 100% or if the number of qualified reactors does not match the number of operated reactors.

*Note 2: Values displayed in red do not meet the 50% criterion and the reactors concerned are disqualified from the calculation of aggregate statistics (including data completeness).

	Weighted Average	Median	Best Quartile	Minimum	Standard Deviation	No. of Operated Reactors
TOTALS:	77.60	78.84	94.01	0.00	23.29	18
CANADA	77.60	78.84	94.01	0.00	23.29	18
2010	77.60	78.84	94.01	0.00	23.29	18
PHWR	77.60	78.84	94.01	0.00	23.29	18

ISO Code	Unit	Type	Model	RUP [MWe]	EAF [%]*
CA	BRUCE-3	PHWR	CANDU 750A	730	68.44
CA	BRUCE-4	PHWR	CANDU 750A	730	94.11
CA	BRUCE-5	PHWR	CANDU 750B	817	93.97
CA	BRUCE-6	PHWR	CANDU 750B	817	76.54
CA	BRUCE-7	PHWR	CANDU 750B	817	93.68
CA	BRUCE-8	PHWR	CANDU 750B	782	98.58
CA	DARLINGTON-1	PHWR	CANDU 850	878	94.48
CA	DARLINGTON-2	PHWR	CANDU 850	878	81.14
CA	DARLINGTON-3	PHWR	CANDU 850	878	97.47
CA	DARLINGTON-4	PHWR	CANDU 850	878	73.26
CA	GENTILLY-2	PHWR	CANDU 6	635	62.75
CA	PICKERING-1	PHWR	CANDU 500A	515	52.73
CA	PICKERING-4	PHWR	CANDU 500A	515	71.13
CA	PICKERING-5	PHWR	CANDU 500B	516	83.73
CA	PICKERING-6	PHWR	CANDU 500B	516	85.83
CA	PICKERING-7	PHWR	CANDU 500B	516	64.78
CA	PICKERING-8	PHWR	CANDU 500B	516	68.16
CA	POINT LEPREAU	PHWR	CANDU 6	635	0.00

FIG. 4-8. Example of the Performance Indicator Report.

Concept:

- The report provides performance indicator values as weighted average, median, best quartile, minimum value and standard deviation for a chosen reactor group.
- The complex information is included in the multiple summary levels it supports. Up to three summary levels enable the user to generate insightful statistics, i.e. by country, reactor type or year.
- The only mandatory parameter for the report is the reporting period ("from" and "to" year). The report may be generated for historical periods up to and including the previous year. By default, the previous year is selected as a reporting period.
- Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, Age, and Year) can be applied to the result set. If age and/or year are selected, any given reactor may be listed in several summary groups.
- The Show Reactor Details option provides reactor level performance indicator values in addition to summary level results. Detailed information about each reactor also includes basic specification information, i.e. name, type, model and RUP in the relevant reporting year.

Condition:

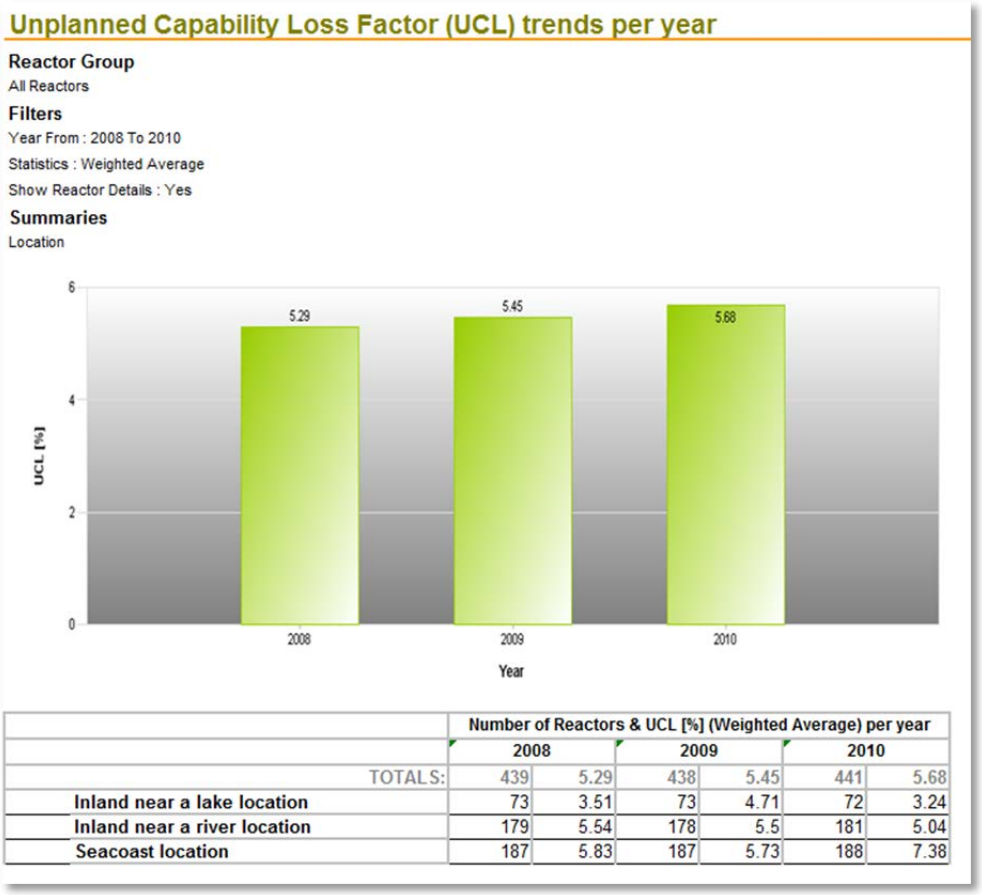
- Except for the scram rates (UA7 and US7) and Load Factor including Heat (LFH), that are calculated from annual production data, the performance indicator values are calculated from monthly production records.
- Monthly production records are filtered to include only months that a reactor was operational, i.e. the period from the reactor's commercial date to its permanent shutdown date, excluding periods of long-term shutdown.
- Reactors that were not operational for at least one month during the reporting period are automatically excluded from the report.
- The 15-day condition is applied to decide whether "borderline" months (the months of the commercial date, the long-term shutdown date, the restart date and the permanent shutdown date) should be included in the calculation.
- For periods/years that data collection is not completed or data is missing, an additional data completeness indicator in percent is displayed. It is calculated as a ratio of number of months that data is available to the number of months a reactor was operational. The data completeness indicator helps the user interpret the reliability/accuracy of the performance indicator values.
- On the summary and report total levels, only reactors that have data completeness > 50% are considered ("qualified reactors"). The qualified reactors column indicates how many reactors out of the operational reactors were considered for summary/totals calculation.
- Reference Unit Power (RUP) refers to the net electrical capacity at the end of the final year of the reporting period (unless grouping by year is selected). In the current year, RUP reflects the latest situation.
- "Age" in the summaries refers to a reactor's age at the end of the reporting period, except when age and year are both selected. In this case, age is calculated separately for each year in the reporting period.

Data Selection:

- Reactor detail information is selected from the Reactor table.
- RUP is taken from the monthly production tables. For historical years without production data RUP is reconstructed by closest available production data or by information in the reactor table.

4.2.5. Trends – Performance Indicators

This report illustrates the historical evolution of performance indicator values over the years. Performance indicator values for each year in the reporting period selected by the user are calculated and displayed as a bar chart, with the data table.



	Number of Reactors & UCL [%] (Weighted Average) per year					
	2008		2009		2010	
TOTALS:	439	5.29	438	5.45	441	5.68
Inland near a lake location	73	3.51	73	4.71	72	3.24
Inland near a river location	179	5.54	178	5.5	181	5.04
Seacoast location	187	5.83	187	5.73	188	7.38

FIG. 4-9. Example of the Performance Indicator Trend Report.

Concept:

- This report provides the evolution of performance indicator values for a chosen group of reactors.
- The report has three mandatory parameters:
  - The reporting period ("from" year – "to" year. A period of up to 20 years can be selected. The default selection is the previous year.
  - The performance indicator (EAF, LF etc.) to be calculated.
  - The statistical value to be used for calculation (weighted average, median, best quartile).
- Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, and Age) can be applied to the result set. When grouping by age is selected, a given reactor will appear in different age groups for each reporting year.
- The Show Reactor Details option provides reactor level performance indicator values in addition to summary-level results.

Condition:

- A maximum of 20 years can be specified for the reporting period.
- Performance indicator values are calculated in the same manner as for the corresponding Performance Indicator report.
- Only reactors with at least 50% data completeness are taken into account. The number of reactors in the PI Trend report is akin to the number of *qualified* reactors in the PI report.

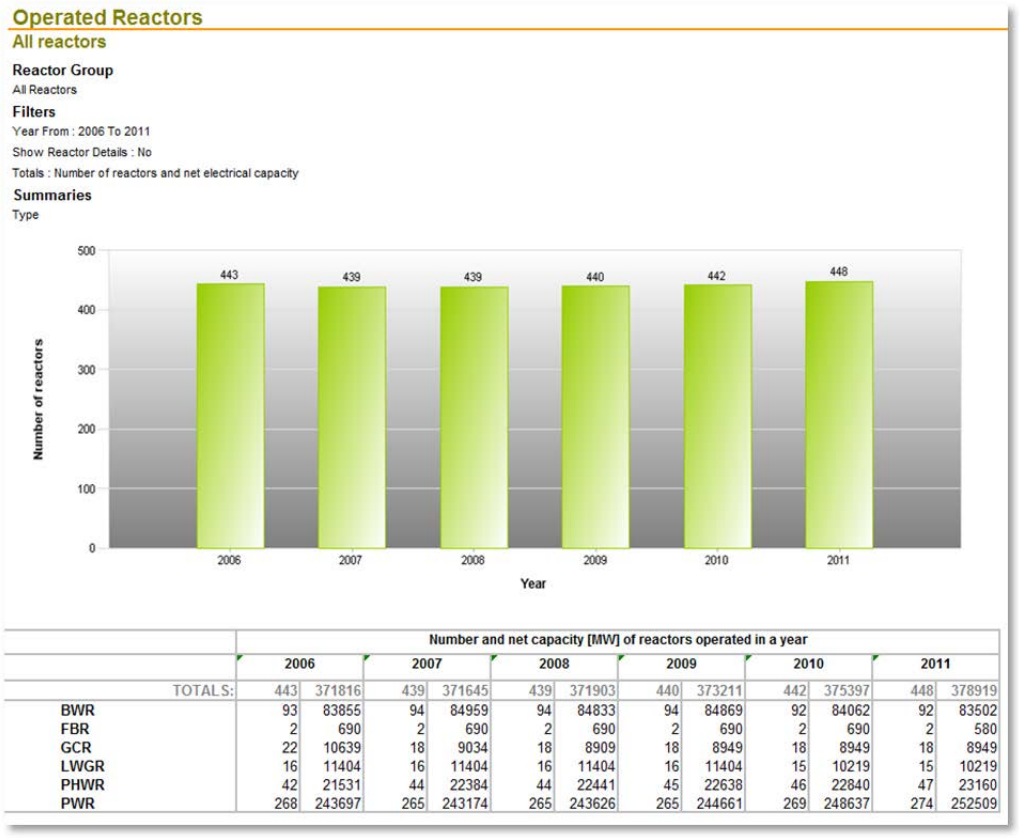
This number can be lower than the number of reactors that were operational during a reporting year.
– Grouping by age refers to a reactor's age at the end of each reporting year.

Data Selection:

– Refer to the Performance Indicator report for more information about data selection.

4.2.6. Trends – Operated Reactors

This report illustrates the number of operated reactors and/or their total net electrical capacity over a selected period. In contrast to the Year-end Reactor Status Trends report, the Operated Reactors report considers all reactors that were operational for at least one day during a reporting year.



	Number and net capacity [MW] of reactors operated in a year											
	2006		2007		2008		2009		2010		2011	
TOTALS:	443	371816	439	371645	439	371903	440	373211	442	375397	448	378919
BWR	93	83855	94	84959	94	84833	94	84869	92	84062	92	83502
FBR	2	690	2	690	2	690	2	690	2	690	2	580
GCR	22	10639	18	9034	18	8909	18	8949	18	8949	18	8949
LWGR	16	11404	16	11404	16	11404	16	11404	15	10219	15	10219
PHWR	42	21531	44	22384	44	22441	45	22638	46	22840	47	23160
PWR	268	243697	265	243174	265	243626	265	244661	269	248637	274	252509

FIG. 4-10. Example of the Operated Reactor Trend Report.

Concept:

– The report contains all reactors that were operated for at least one day in one of the years of the reporting period.
– The report can be generated for historical periods up to and including the current year. By default, the report is generated for the current year.
– If the user only enters a "from" year and leaves the "to" year of the reporting period blank, the report is generated for one year, i.e. the "from" year.

- Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, and Age) may be applied to the result set. A reactor can only appear in exactly one group in the result set.
- The user has the choice of three summary options:
    - Number of reactors: the bar chart illustrates the total number of operational reactors for each year in the reporting period. Summary level information in the data table includes the number of reactors for each group, for each year.
    - Net electrical capacity: the bar chart illustrates the total net electrical capacity of operational reactor units (MWe) for each year in the reporting period. Summary level information in the data table includes the total net electrical capacity of reactor units for each group, for each year.
    - Number of reactors and net electrical capacity: the bar chart illustrates the total number of operational reactors for each year in the reporting period. Summary level information in the data table includes the number of reactors and the total net electrical capacity for each group, for each year.
- The *Show Reactor Details* option includes reactor level information in addition to summary level results. Detailed information includes the name and net electrical capacity of each reactor, for each year in the reporting period.

Condition:

- The difference between status year-end report for operational reactors and operated reactor reports should be well understood. "Operational reactors" in the year-end status report are those reactors that were in operation at the end of the year. "Operated reactors" in this report are reactors that were in operation at any time during the year. As a result, this report also considers reactors that were operated but were shutdown (permanently or long-term) during the year.
- For some years there is a difference in reactor numbers in "Electricity Supplied" and "Performance Indicator" reports because electricity supplied is reported from the "Grid Date" (first connection of the reactor unit to the grid) while PI reports are calculated for commercial operation (from the "Commercial Date"). In some cases a reactor unit was connected to the grid (and supplied electricity) in the reported year but started commercial operation in a following year (or later). Therefore, the reactor is included in operated reactors but not in PI reports of that year.
- A maximum of 20 years can be specified for the reporting period.
- The report reflects individual reactor units and their RUP at the end of a selected year. In a case of current year it reflects the latest situation.
- Reactors in long-term shutdown are not queried in the report.
- Results in this report can differ from status year-end reports which reflect situation at the end of a year. Reactors shut down (permanently or into long-term shutdown) during a year are counted in the operated reactor reports but not in year-end reports.
- A reactor is considered in operation from the Grid Date. Number of reactors in this report can differ from the PI report which includes only reactors in commercial operation.
- RUP relates to the end of each particular year.
- Age in "Summaries" relates to each particular year.

Data Selection:

- Reactor detail information is from reactor and site tables of the PRIS database.
- RUP is calculated from monthly production data to reflect RUP revisions. The closest available match from the Annual Electricity Reconstruction table is used.

4.3. Worldwide Statistics – Tables

The 25 reports/tables in the Worldwide Statistics section provide a global overview of nuclear power. They are equivalent to the tables published in the IAEA annual publication, "Nuclear Power Reactors in the World" (RDS-2). The last number of the following subchapters corresponds to the number of the table in RDS-2.

Concept:

- The reports are applied to all reactors worldwide. As a consequence, reactor group selection is not available.
- The only report criterion is "base year" for the report. By default, the previous year is selected. Three reports (scheduled connections to the grid, planned reactors, and decommissioning process/decommissioned) do not require a base year selection.

Condition:

- The reports query all reactors in the world.

4.3.1. Reactor Overview and Nuclear Share (Table 1)

This report provides an overview by country of the reactors under construction, in operation and in long-term shutdown in a given year. In addition, it includes information about the total nuclear energy production [TW·h] and the nuclear energy share [%] of each country.

Reactors Overview and Nuclear Electricity Share

Reactor Status and Electricity Production, latest in 2010

Country	Reactors in Operation		Long Term Shutdown Reactors		Reactors Under Construction		Nucelar Electricity Supplied	
	Number of Units	Total Capacity MW(e)	Number of Units	Total Capacity MW(e)	Number of Units	Total Capacity MW(e)	TW(e).h	% of Total
ARGENTINA	2	935			1	692	6.69	5.91
ARMENIA	1	375					2.29	39.42
BELGIUM	7	5926					45.73	51.16
BRAZIL	2	1884			1	1245	13.90	3.06
BULGARIA	2	1906			2	1906	14.24	33.13
CANADA	18	12569	4	2726			85.50	15.07
CHINA	13	10058			29	28250	70.96	1.82
CZECH REP.	6	3678					26.44	33.27
FINLAND	4	2716			1	1600	21.89	28.43
FRANCE	58	63130			1	1600	410.09	74.12
GERMANY	17	20490					133.01	22.62
HUNGARY	4	1889					14.66	42.10
INDIA	19	4189			6	3766	20.48	2.85
IRAN,ISL.REP					1	915	NA	NA
JAPAN	54	46821	1	246	2	2650	280.25	29.21
KOREA REP.	21	18698			5	5560	141.89	32.18
MEXICO	2	1300					5.59	3.59
NETHERLANDS	1	482					3.75	3.38
PAKISTAN	2	425			1	300	2.56	2.60
ROMANIA	2	1300					10.70	19.48
RUSSIA	32	22693			11	9153	159.41	17.09
SLOVAKIA	4	1816			2	782	13.54	51.80
SLOVENIA	1	666					5.38	37.30
SOUTH AFRICA	2	1800					12.90	5.18
SPAIN	8	7514					59.26	20.09
SWEDEN	10	9303					55.73	38.13
SWITZERLAND	5	3238					25.34	38.01
TAIWAN, CN	6	4982			2	2600	39.89	19.30

FIG. 4-11. Table 1 Report.

Condition:

- The nuclear energy production for each country is calculated from monthly production data. It includes data for all months of a reactor's operation from grid connection to shutdown, excluding periods of long-term shutdown.

– The nuclear energy share is calculated as a percentage of nuclear energy production / total production and is based on country annual data.
– Reactor data is calculated as follows depending on a reactor's status:
    - *Reactors under Construction:*
      When generated for the current year, the report considers only reactors that are currently "under construction". When generated for a past year, the report determines whether a reactor was under construction in the reporting year by considering its current status, construction date and grid date.
      Note: The report does not consider reactors in current status "cancelled construction" or "suspended construction", even if they might have been under construction in the reporting year.
    - *Operational Reactors:*
      When generated for the current year, the report considers only reactors that are currently "operational". When generated for a year in the past, the report considers reactors that have been operational at the end of the reporting year.
    - *Reactors in Long-term Shutdown:*
      A reactor is considered to be in long-term shutdown if the long-term shutdown started before December of the reporting year and did not end before January of the following year.
– Net electrical capacity is calculated as follows for different reactor status:
    - *Reactors under Construction:*
      The design net electrical capacity is used.
    - *Operational Reactors:*
      Capacity in the year of the report, reconstructed from historical data (or the latest net electrical capacity if the report is generated for the current year).
    - *Reactors in Long-term Shutdown:*
      Capacity in the month before the long-term shutdown (reconstructed from monthly production data). The latest net electrical capacity is used if the capacity immediately before the shutdown is not available.

Data Selection:

– Depending on reactor status, RUP is selected from the Annual Electricity Reconstruction, Monthly Production or Reactor table (see above).
– Energy production and nuclear energy share are calculated from data in the Country Annual table.

4.3.2. Operational Reactors by Type (Table 2)

This report provides an overview of the number of operational reactor units and their total net electrical capacity by country and by reactor type.

Type and Net Electrical Power of Reactors connected to the Grid

Latest in 2010

Country	PWR		BWR		GCR		PHWR		LWGR		FBR		Totals	
	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)
ARGENTINA							2	935					2	935
ARMENIA	1	375											1	375
BELGIUM	7	5926											7	5926
BRAZIL	2	1884											2	1884
BULGARIA	2	1906											2	1906
CANADA							18	12569					18	12569
CHINA	11	8758					2	1300					13	10058
CZECH REP.	6	3678											6	3678
FINLAND	2	976	2	1740									4	2716
FRANCE	58	63130											58	63130
GERMANY	11	14033	6	6457									17	20490
HUNGARY	4	1889											4	1889
INDIA			2	300			17	3889					19	4189
JAPAN	24	19284	30	27537									54	46821
KOREA REP.	17	15976					4	2722					21	18698
MEXICO			2	1300									2	1300
NETHERLANDS	1	482											1	482
PAKISTAN	1	300					1	125					2	425
ROMANIA							2	1300					2	1300
RUSSIA	16	11914							15	10219	1	560	32	22693
SLOVAKIA	4	1816											4	1816
SLOVENIA	1	666											1	666
SOUTH AFRICA	2	1800											2	1800
SPAIN	6	6004	2	1510									8	7514
SWEDEN	3	2799	7	6504									10	9303
SWITZERLAND	3	1700	2	1538									5	3238
TAIWAN, CN	2	1841	4	3141									6	4982
UK	1	1188			18	8949							19	10137

FIG. 4-12. Table 2 Report.

Condition:

- When generated for the current year, the report only considers reactors that are currently in the status "operational".
- When generated for a year in the past, the report considers reactors that have been operational at the end of the reporting year by applying the following conditions:
  - The reactor is *currently* in the status "operational", "long-term shutdown" or "permanent shutdown".
  - Its grid date is in or before the reporting year.
  - Its permanent shutdown date is past the reporting year.
  - It was not in long-term shutdown in December of the reporting year.
- Capacity is calculated as follows:
  - Capacity in the year of the report (by default);
  - Latest net electrical capacity if the capacity in the year of the report is not available;
  - Or design net electrical capacity.

Data Selection:

- Reactor basic information, including country and type are selected from the Reactor table.
- RUP is selected from the Annual Production table, if available, or from the Reactor table.

4.3.3. Reactors Under Construction by Type (Table 3)

This report provides an overview of the *number of reactors under construction* and their total net electrical capacity by country and by reactor type.

Type and Net Electrical Power of reactors under construction

Latest in 2010

Country	PWR		BWR		PHWR		LWGR		FBR		Totals	
	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)
ARGENTINA					1	692					1	692
BRAZIL	1	1245									1	1245
BULGARIA	2	1906									2	1906
CHINA	28	28230							1	20	29	28250
FINLAND	1	1600									1	1600
FRANCE	1	1600									1	1600
INDIA	2	1834			3	1462			1	470	6	3766
IRAN,ISL.REP	1	915									1	915
JAPAN			2	2650							2	2650
KOREA REP.	5	5560									5	5560
PAKISTAN	1	300									1	300
RUSSIA	9	7434					1	915	1	804	11	9153
SLOVAKIA	2	782									2	782
TAIWAN, CN			2	2600							2	2600
UKRAINE	2	1900									2	1900
USA	1	1165									1	1165
WORLDWIDE	**56**	**54471**	**4**	**5250**	**4**	**2154**	**1**	**915**	**3**	**1294**	**68**	**64084**

FIG. 4-13. Table 3 Report.

Condition:

– When generated for the current year, the report considers only reactors that are currently in the status "under construction".
– When generated for a year in the past, the report determines whether a reactor was under construction in the reporting year by considering the reactor's current status, its construction date and its grid date. It includes reactors:
    - In the status "under construction", "operational", "long-term shutdown" and "permanent shutdown" if the reporting year is between the year of the construction date and the year of the grid date.
    - In the status "suspended construction" and "cancelled construction" if the date of cancellation/suspension (shut-down date) is past the reporting year.
– Capacity is the design net electrical capacity.

Data Selection:

– All information in this report is selected from the Reactor table.

4.3.4. Reactor-Years of Operation (Table 4)

This report provides an overview by country of the reactors contributing to operating experience (in operation, in long-term shutdown and in permanent shutdown) up to the end of a reported year. The report includes the total operating experience (in years and months) per country.

Operating Experience

Reactor-Years of Operating Experience, up to end of 2010

Country	In Operation		Long Term Shutdown		Permanently Shutdown		All Operating and Shutdown Reactors		Operating Experience	
	Number	Net Capacity MW(e)	Number	Net Capacity MW(e)	Number	Net Capacity MW(e)	Number	Net Capacity MW(e)	Years	Months
ARGENTINA	2	935					2	935	64	7
ARMENIA	1	375			1	376	2	751	36	8
BELGIUM	7	5926			1	10	8	5936	240	7
BRAZIL	2	1884					2	1884	39	3
BULGARIA	2	1906			4	1632	6	3538	149	3
CANADA	18	12569	4	2726	3	478	25	15773	600	2
CHINA	13	10058					13	10058	111	2
CZECH REP.	6	3678					6	3678	116	10
FINLAND	4	2716					4	2716	127	4
FRANCE	58	63130			12	3789	70	66919	1758	4
GERMANY	17	20490			19	5879	36	26369	768	5
HUNGARY	4	1889					4	1889	102	2
INDIA	19	4189					19	4189	337	3
ITALY					4	1423	4	1423	81	0
JAPAN	54	46821	1	246	5	1618	60	48685	1494	8
KAZAKHSTAN					1	52	1	52	25	10
KOREA REP.	21	18698					21	18698	360	1
LITHUANIA					2	2370	2	2370	43	6
MEXICO	2	1300					2	1300	37	11
NETHERLANDS	1	482			1	55	2	537	66	0
PAKISTAN	2	425					2	425	49	10
ROMANIA	2	1300					2	1300	17	11
RUSSIA	32	22693			5	786	37	23479	1026	5
SLOVAKIA	4	1816			3	909	7	2725	136	7
SLOVENIA	1	666					1	666	29	3
SOUTH AFRICA	2	1800					2	1800	52	3
SPAIN	8	7514			2	621	10	8135	277	6

FIG. 4-14. Table 4 Report.

Condition:

- The number and capacity of operational reactors and reactors in long-term shutdown are calculated following the same rules as Table 1 (Reactor Overview and Nuclear Share).
- The rules applied for selecting reactors in permanent shutdown are:
  - When generated for the current year, the report considers only reactors that are currently in status “shutdown”.
  - When generated for a year in the past, the report considers reactors that are currently in status “permanent shutdown” and their shutdown date is in or before the reporting year.
- The basic rule for calculating the operating experience in months per reactor is to count the number of months that a reactor was operational for at least one day, i.e. from its grid date to its permanent shutdown date, excluding periods of long-term shutdown.
- The operating experience includes the months of the grid date, long-term shutdown and restart date and the permanent shutdown date.

Data Selection:

- Operating experience is calculated from the dates in the Reactor table and does not rely on production data.

4.3.5. History of Operating Reactors (Table 5)

This report displays the number of operating reactor units and their net electrical capacity per country for the past 30 years. It provides a snapshot view of reactor count and capacity in five year intervals, in addition to data for the reporting year and the previous year.

Operating Reactors and Net Electrical Power, 1980 to 2010

Country	Number of Units and Net Capacity [MW(e)] Connected to the Grid (Latest in each year)															
	1980		1985		1990		1995		2000		2005		2009		2010	
	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)	No.	MW(e)
ARGENTINA	1	335	2	935	2	935	2	935	2	978	2	935	2	935	2	935
ARMENIA	2	816	2	816			1	376	1	376	1	376	1	375	1	375
BELGIUM	4	1670	8	5464	7	5501	7	5631	7	5712	7	5801	7	5902	7	5926
BRAZIL			1	626	1	626	1	626	2	1976	2	1901	2	1884	2	1884
BULGARIA	3	1224	4	1632	5	2585	6	3538	6	3760	4	2722	2	1906	2	1906
CANADA	10	5172	16	9741	20	13993	21	14902	14	9998	18	12584	18	12569	18	12569
CHINA							3	2188	3	2188	9	6587	11	8438	13	10058
CZECH REP.			1	391	4	1632	4	1782	5	2611	6	3373	6	3678	6	3678
FINLAND	4	2208	4	2300	4	2310	4	2310	4	2656	4	2676	4	2696	4	2716
FRANCE	22	14388	43	37478	56	55808	56	58573	59	63080	59	63260	59	63260	58	63130
GERMANY	19	10323	24	18110	21	21250	19	20972	19	21283	17	20339	17	20480	17	20490
HUNGARY			2	825	4	1710	4	1729	4	1729	4	1755	4	1889	4	1889
INDIA	4	832	6	1143	7	1324	10	1746	14	2508	15	2993	18	3987	19	4189
ITALY	4	1112	3	1273												
JAPAN	23	14918	33	23612	41	30867	50	39625	52	43245	55	47593	54	46821	54	46821
KAZAKHSTAN	1	135	1	135	1	135	1	50								
KOREA REP.	1	564	5	3692	9	7220	11	9115	16	12990	20	16810	20	17705	21	18698
LITHUANIA			1	1380	2	2760	2	2370	2	2370	1	1185				
MEXICO					1	640	2	1256	2	1290	2	1360	2	1300	2	1300
NETHERLANDS	2	498	2	508	2	539	2	510	1	449	1	450	1	487	1	482
PAKISTAN	1	125	1	137	1	125	1	125	2	425	2	425	2	425	2	425
ROMANIA									1	655	1	655	2	1300	2	1300
RUSSIA	20	8596	28	15841	29	18898	30	19848	30	19848	31	21743	31	21743	32	22693
SLOVAKIA	2	780	4	1632	4	1632	4	1632	6	2440	6	2442	4	1762	4	1816
SLOVENIA			1	632	1	620	1	620	1	676	1	656	1	666	1	666
SOUTH AFRICA			2	1840	2	1840	2	1840	2	1840	2	1800	2	1800	2	1800
SPAIN	3	1073	8	5608	9	7099	9	7097	9	7468	9	7591	8	7450	8	7514
SWEDEN	8	5510	12	9455	12	9826	12	10043	11	9412	10	8905	10	9036	10	9303
SWITZERLAND	4	1940	5	2881	5	2942	5	3056	5	3170	5	3220	5	3238	5	3238

FIG. 4-15. Table 5 Report.

Condition and Data Selection:

The number of reactors and the capacity of operational reactors are calculated in the same way as Table 1. The report is thus equivalent to the "operational" reactors column in Table 1, as if the report for Table 1 were generated for each particular year in Table 5.

4.3.6. History of Electricity Production (Table 6)

This report displays the history of annual nuclear energy production and nuclear energy share per country for the past 30 years. It provides a snapshot of energy production [TWh] and nuclear energy share [%] in five year intervals up to the reporting year.

Nuclear electricity production and share from 1980 to 2010

Country	Nuclear production [TW(e).h] of reactors connected to the Grid (Latest in each year)															
	1980		1985		1990		1995		2000		2005		2009		2010	
	TW(e).h	% of Total	TW(e).h	% of Total	TW(e).h	% of Total	TW(e).h	% of Total	TW(e).h	% of Total	TW(e).h	% of Total	TW(e).h	% of Total	TW(e).h	% of Total
ARGENTINA	2.18	NA	5.25	11.7	6.72	19.8	6.57	11.8	5.74	7.3	6.37	6.9	7.59	7.0	6.69	5.9
ARMENIA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	1.84	33.0	2.50	42.7	2.29	45.0	2.29	39.4
BELGIUM	11.86	NA	29.25	59.8	40.59	60.1	39.30	55.5	45.81	56.8	45.34	55.6	44.96	51.6	45.73	51.2
BRAZIL	0.00	NA	3.17	1.6	2.06	1.0	2.33	1.0	5.59	1.9	9.20	2.5	12.22	2.9	13.90	3.1
BULGARIA	5.71	NA	12.17	31.6	13.51	35.7	16.22	46.4	16.79	45.0	17.38	44.1	14.22	35.9	14.24	33.1
CANADA	38.02	NA	59.47	12.7	69.87	14.8	93.98	17.3	69.12	11.8	86.83	14.5	85.13	14.8	85.50	15.1
CHINA	0.00	NA	0.00	NA	0.00	NA	12.13	1.2	16.02	1.2	50.33	2.0	65.71	1.9	70.96	1.8
CZECH REP.	0.00	NA	1.99	NA	11.77	NA	12.23	20.0	12.71	18.7	23.25	30.5	25.66	33.8	26.44	33.3
FINLAND	6.68	NA	17.98	38.2	18.13	35.0	18.13	29.9	21.58	32.2	22.36	32.9	22.60	32.9	21.89	28.4
FRANCE	57.31	NA	213.28	64.8	297.61	74.5	358.71	76.1	395.39	76.4	431.18	78.5	391.75	75.2	410.09	74.1
GERMANY	41.44	NA	119.59	31.2	139.37	33.1	146.13	29.6	160.66	30.6	154.61	26.6	127.72	22.9	133.01	22.6
HUNGARY	0.00	NA	6.10	23.6	12.89	51.4	13.20	42.3	13.35	40.6	13.02	37.2	14.30	43.0	14.66	42.1
INDIA	2.77	NA	3.87	2.2	5.29	2.2	6.99	1.9	14.23	3.1	15.73	2.8	14.75	2.2	20.48	2.8
ITALY	2.11	NA	6.46	3.8	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA
JAPAN	79.11	NA	145.37	22.7	187.19	27.1	275.51	33.4	306.24	33.8	280.50	29.3	263.05	29.2	280.25	29.2
KAZAKHSTAN	0.00	NA	0.00	NA	0.00	NA	0.08	0.1	0.00	NA	0.00	NA	0.00	NA	0.00	NA
KOREA REP.	3.26	NA	12.36	23.2	50.26	49.1	60.21	36.1	103.54	40.7	137.59	44.7	141.12	34.8	141.89	32.2

FIG. 4-16. Table 6 Report.

Condition and Data Selection:

The report uses the same formulas and conditions for nuclear share that are used in Table 1. The energy production and nuclear energy share values in particular years are thus equivalent to Table 1 for those years.

4.3.7. Historical Development (Table 7)

This report presents the number of construction starts, grid connections and operational reactors for each year since 1954.

Annual statistics excluding unfinished constructions, 1954 to 2010

Year	Construction Starts		Connections to the Grid		Reactors in operation	
	Units	MW(e)	Units	MW(e)	Units	MW(e)
1954	1	60	1	5	1	5
1955	8	260	0		1	5
1956	5	577	1	35	2	65
1957	13	1836	3	119	5	209
1958	6	476	1	35	6	269
1959	7	976	5	176	11	548
1960	11	1010	4	438	15	1087
1961	7	1531	1	15	16	1104
1962	8	1379	9	955	25	2223
1963	5	1722	9	500	33	2677
1964	9	2866	8	1022	40	3686
1965	9	3291	8	1879	48	5910
1966	15	7052	8	1530	55	7539

FIG. 4-17. Table 7 Report.

Condition:

- Construction starts are counted in the year of a reactor's construction date.
- Grid connections are counted in the year of a reactor's grid date.
- Operational reactors are counted in any year from the year of their grid date to the year preceding their shutdown date; excluding years of long-term shutdown (see Table 1 for more details).
- The capacity for reactor units with construction starts and connection to the grid is the design net capacity.
- The capacity column for operational reactor units is the total net electrical capacity of all units that were operational in a given year.

Data Selection:

- If available, RUP for operational reactor units is selected from the Annual Electricity Reconstruction table. Alternatively, the latest net electrical capacity from the Reactor table is used.

4.3.8. Construction Time Span (Table 8)

This report provides a historical overview of the number of reactor units connected to the grid during the past 35 years, in five year periods. For each country and five year period, the number of reactor units connected to the grid is given, together with the median construction time span for the reactors in months.

Number of new reactors connected to the grid and median construction time span

Country	1976 to 1980		1981 to 1985		1986 to 1990		1991 to 1995		1996 to 2000		2001 to 2005		2006 to 2010	
	No.	Months	No.	Months	No.	Months	No.	Months	No.	Months	No.	Months	No.	Months
ARGENTINA			1	109										
ARMENIA	2	73												
BELGIUM			4	80										
BRAZIL			1	132					1	176				
BULGARIA	1	87	1	104	1	89	1	113						
CANADA	4	69	7	98	5	101	2	97						
CHINA							3	73			6	60	2	80
CZECH REP.			1	74	3	93			1	167	1	191		
FINLAND	4	63												
FRANCE	13	66	24	68	15	86	3	93	4	124				
GERMANY	9	68	7	100	6	103								
HUNGARY			2	112	2	90								
INDIA	1	152	2	154	1	152	3	120	4	122	1	64	3	74
ITALY	1	101												
JAPAN	11	61	10	46	8	49	10	46	3	42	4	47	1	53
KOREA REP.	1	63	4	65	4	62	2	61	5	59	4	54		
LITHUANIA			1	80	1	116								
MEXICO					1	151	1	210						
PAKISTAN									1	83				
ROMANIA									1	169			1	161
RUSSIA	6	74	9	73	4	72	1	109			2	233		
SLOVAKIA	2	89	2	99					2	119				
SLOVENIA			1	80										
SOUTH AFRICA			2	102										
SPAIN			5	112	2	96								
SWEDEN	3	85	4	74										
SWITZERLAND	1	63	1	125										
TAIWAN, CN	2	64	4	72										

FIG. 4-18. Table 8 Report.

Condition:

- The construction time span for each reactor is calculated as the difference in months between a reactor's construction date and its grid date, excluding periods during which construction was suspended.
- The months of the construction start and grid connection are included in the time span, as are the months of the construction suspension and restart (where applicable).
- Each reactor is counted in the time interval when it was connected to the grid (grid date).

Data Selection:

- All data required for the report is selected from the Reactor and Long-term Shutdown Details tables.

4.3.9. Construction Starts (Table 9)

This report lists all reactors that began construction in a selected reporting year.

Construction starts during 2010

Country	Reactor		Type	Model	Capacity [MW]			Operator	NSSS Supplier	Construction start	Grid Connection	Commercial Operation
	Code	Name			Thermal	Gross	Net					
BRAZIL	BR -3	ANGRA-3	PWR	PRE KONVOI	3765	1350	1245	ELETRONU	KWU	2010-6		2018-12
CHINA	CN -51	CHANGJIANG 1	PWR	CNP-600	1930	650	610	HNPC	DFEC	2010-4		
CHINA	CN -52	CHANGJIANG 2	PWR	CNP-600	1930	650	610	HNPC	DFEC	2010-11		2015-12
CHINA	CN -55	FANGCHENGGANG 1	PWR	CPR1000	2905	1087	1000	GFNPC	DFEC	2010-7		
CHINA	CN -56	FANGCHENGGANG 2	PWR	CPR1000	2905	1087	1000	GFNPC	DFEC	2010-12		
CHINA	CN -47	FUQING 3	PWR	CPR-1000	2905	1087	1000	FQNP	DFEC	2010-12		2015-7
CHINA	CN -25	HAIYANG 2	PWR	AP-1000	3750	1250	1000	SNPC	WH	2010-6		
CHINA	CN -38	NINGDE 3	PWR	CPR1000	2905	1080	1000	NDNPC	DFEC	2010-1		
CHINA	CN -39	NINGDE 4	PWR	CPR1000	2905	1080	1000	NDNPC	DFEC	2010-9		
CHINA	CN -35	TAISHAN 2	PWR	EPR-1700	4500	1750	1700	TNPC	AREVA	2010-4		
CHINA	CN -43	YANGJIANG 3	PWR	CPR1000	2905	1087	1000	YJNPC	DFEC	2010-11		
INDIA	IN -30	KAKRAPAR-3	PHWR	PHWR-700	2166	700	630	NPCIL	NPCIL	2010-11	2015-3	2015-6
INDIA	IN -31	KAKRAPAR-4	PHWR	PHWR-700	2166	700	630	NPCIL	NPCIL	2010-11	2015-9	2015-12
JAPAN	JP -66	OHMA	BWR	ABWR	3926	1383	1325	EPDC	H/G	2010-5		2014-11
RUSSIA	RU -164	LENINGRAD 2-2	PWR	VVER V-491	3200	1170	1085	REA	ROSATOM	2010-4		
RUSSIA	RU -64	ROSTOV-4	PWR	VVER V-320	3000	1070	1011	REA	ROSATOM	2010-6		
WORLDWIDE		Construction starts:		16	Total Net Capacity:		15846	[MW]				

FIG. 4-19. Table 9 Report.

Condition:

- A reactor is included in the report if it is currently under construction, operational, in long-term shutdown or in permanent shutdown, and if its construction start date falls within the reporting year.
- Net electrical capacity is the design net electrical capacity.

4.3.10. Connections to the Grid (Table 10)

This report lists all reactor units that were connected to the grid in a given reporting year.

10: Connections to the Grid during 2010

Country	Reactor		Type	Model	Capacity [MW]			Operator	NSSS Supplier	Construction start	First Critically	Grid Connection
	Code	Name			Thermal	Gross	Net					
CHINA	CN -12	LINGAO 3	PWR	CPR1000	2905	1080	1000	LDNPC	DFEC	2005-12	2010-6	2010-7
	CN -14	QINSHAN 2-3	PWR	CNP600	1930	650	610	NPQJVC	CNNC	2006-3	2010-7	2010-8
INDIA	IN -20	RAJASTHAN-6	PHWR	Horizontal Pre	801	220	202	NPCIL	NPCIL	2003-1	2010-1	2010-3
KOREA REP.	KR -21	SHIN-KORI-1	PWR	OPR-1000	2825	1048	1001	KHNP	DHICKOPC	2006-6	2010-7	2010-8
RUSSIA	RU -62	ROSTOV-2	PWR	VVER V-320I	3200	1000	950	REA	ROSATOM	1983-5	2010-1	2010-3
WORLDWIDE		Grid connections:		5	Total Net Capacity:		3763	[MW]				

FIG. 4-20. Table 10 Report.

Condition:

- A reactor is included in the report if it is currently operational, in long-term shutdown or in permanent shutdown, and its grid date falls within the reporting year.
- Net electrical capacity is the design net electrical capacity.

4.3.11. Scheduled Connections to the Grid (Table 11)

This report lists all reactor units that are scheduled to be connected to the grid in the current calendar year.

Scheduled connection to the Grid during 2011

Country	Reactor		Type	Model	Capacity [MW]			Operator	NSSS Supplier	Construction start	First Criticality	Grid Date
	Code	Name			Thermal	Gross	Net					
CHINA	CN -84	CEFR	FBR	BN20	65	25	20	CIAE	IZ	2000-5	2010-7	2011-7
CHINA	CN -13	LINGAO 4	PWR	CPR1000	2905	1080	1000	LDNPC	DFEC	2006-6	2011-2	2011-5
INDIA	IN -16	KAIGA-4	PHWR	Horizontal Pres	800	220	202	NPCIL	NPCIL	2002-5	2010-11	2011-1
INDIA	IN -25	KUDANKULAM-1	PWR	VVER V-412	3000	1000	917	NPCIL	MAEP	2002-3	2011-11	2011-12
IRAN,ISL.REP	IR -1	BUSHEHR 1	PWR	VVER V-446	3000	1000	915	NPPDCO	ASE	1975-5	2011-5	2011-9
JAPAN	JP -65	SHIMANE-3	BWR	ABWR	3926	1373	1325	CHUGOKU	HITACHI	2007-10		2011-12
PAKISTAN	PK -3	CHASNUPP 2	PWR	PWR	999	325	300	PAEC	CNNC	2005-12	2011-2	2011-3
RUSSIA	RU -37	KALININ-4	PWR	VVER V-320	3200	1000	950	REA	ROSATOM	1986-8	2011-10	2011-11
TAIWAN, CN	TW -7	LUNGMEN 1	BWR	ABWR	3926	1350	1300	TPC	GE	1999-3	2011-10	2011-11
WORLDWIDE	Scheduled grid connections:		9		Total Net Capacity:		6929	[MW]				

FIG. 4-21. Table 11 Report.

Condition:

- The report can only be generated for the current year (no historical information available).
- The report includes all reactors with a planned grid date or in absence of a grid date (commercial date) in the current year.
- Net electrical capacity is the design net electrical capacity from the Reactor table or the latest net electrical capacity if the design has been modified.

4.3.12. Planned Reactors (Table 12)

This report lists all reactors that are in “planned” status in the reporting year. It can only be generated for the current calendar year.

Reactors planned for construction

Latest in 2011

Country	Reactor		Type	Model	Capacity [MW]			Operator	NSSS	Expected
	Code	Name			Thermal	Gross	Net		Supplier	construction start
CHINA	CN -42	BAMAOSHAN	PWR	CRP-1000		1080	900			
CHINA	CN -53	CHANGJIANG 3	PWR		1930	650	610			
CHINA	CN -54	CHANGJIANG 4	PWR		1930	650	610			
CHINA	CN -57	FANGCHENGGANG 3	PWR				1000			
CHINA	CN -58	FANGCHENGGANG 4	PWR				1000			
CHINA	CN -59	FANGCHENGGANG 5	PWR				1000			
CHINA	CN -60	FANGCHENGGANG 6	PWR				1000			
CHINA	CN -48	FUQING 4	PWR	CPR-1000	2905	1087	1000	FQNP	DFEC	
CHINA	CN -49	FUQING 5	PWR	CPR-1000	2905	1087	1000	FQNP	DFEC	
CHINA	CN -50	FUQING 6	PWR	CPR-1000	2905	1087	1000	FQNP	DFEC	
CHINA	CN -76	HAIYANG 3	PWR	AP-1000	3750	1250	1000	SNPC	WH	
CHINA	CN -77	HAIYANG 4	PWR	AP-1000	3750	1250	1000	SNPC	WH	
CHINA	CN -26	HONGSHIDING 1	PWR				0			
CHINA	CN -27	HONGSHIDING 2	PWR				0	HONGYANH	DFEC	
CHINA	CN -80	HONGYANHE 5	PWR	CPR-1000	2905	1080	1000	LHNPC	DFEC	
CHINA	CN -81	HONGYANHE 6	PWR	CPR-1000	2905	1080	1000	LHNPC	DFEC	
CHINA	CN -65	JIYANG 1	PWR				1000			
CHINA	CN -66	JIYANG 2	PWR				1000			
CHINA	CN -67	JIYANG 3	PWR				1000			
CHINA	CN -68	JIYANG 4	PWR				1000			
CHINA	CN -61	PENGZE 1	PWR				1250			
CHINA	CN -62	PENGZE 2	PWR				1250			
CHINA	CN -63	PENGZE 3	PWR				1250			
CHINA	CN -64	PENGZE 4	PWR				1250			
CHINA	CN -78	SANMEN 3	PWR	AP-1000	3750	1250	1000	SMNPC	WH/MHI	
CHINA	CN -79	SANMEN 4	PWR	AP-1000	3750	1250	1000	SMNPC	WH/MHI	
CHINA	CN -70	SANMING-1	FBR	BN800			800	FSNPC		

FIG. 4-22. Table 12 Report.

Condition:

- The report includes all reactors that are currently in “planned” status.
- Net electrical capacity is the design net electrical capacity from the Reactor table or, if unavailable, the latest net electrical capacity from the Reactor table.

4.3.13. Reactors under Construction (Table 13)

This report lists all reactors that are/were under construction in the reporting year.

Reactors under construction

Latest in 2010

Country	Reactor		Type	Model	Capacity [MW]			Operator	NSSS	Construction	First	Grid
	Code	Name			Thermal	Gross	Net		Supplier	start	Criticality	Connection
ARGENTINA	AR -3	ATUCHA-2	PHWR	PHWR KWU	2160	745	692	NASA	SIEMENS	1981-7		2012-7
BULGARIA	BG -7	BELENE-1	PWR	VVER V-466	3000	1000	953	KOZNPP	ASE	1987-1		
BULGARIA	BG -8	BELENE-2	PWR	VVER V-466	3000	1000	953	KOZNPP	ASE	1987-3		
BRAZIL	BR -3	ANGRA-3	PWR	PRE KONVOI	3765	1350	1245	ELETRONU	KWU	2010-6		
CHINA	CN -84	CEFR	FBR	BN20	65	25	20	CIAE	IZ	2000-5	2010-7	2011-7
CHINA	CN -51	CHANGJIANG 1	PWR	CNP-600	1930	650	610	HNPC	DFEC	2010-4		
CHINA	CN -52	CHANGJIANG 2	PWR	CNP-600	1930	650	610	HNPC	DFEC	2010-11		
CHINA	CN -55	FANGCHENGGANG 1	PWR	CPR1000	2905	1087	1000	GFNPC	DFEC	2010-7		
CHINA	CN -56	FANGCHENGGANG 2	PWR	CPR1000	2905	1087	1000	GFNPC	DFEC	2010-12		
CHINA	CN -28	FANGJIASHAN 1	PWR	CPR-1000	2905	1087	1000	QNPC	DFEC	2008-12		
CHINA	CN -29	FANGJIASHAN 2	PWR	CPR-1000	2905	1087	1000	QNPC	DFEC	2009-7		
CHINA	CN -30	FUQING 1	PWR	CPR-1000	2905	1087	1000	FQNP	DFEC	2008-11		
CHINA	CN -31	FUQING 2	PWR	CPR-1000	2905	1087	1000	FQNP	DFEC	2009-6		
CHINA	CN -47	FUQING 3	PWR	CPR-1000	2905	1087	1000	FQNP	DFEC	2010-12		
CHINA	CN -24	HAIYANG 1	PWR	AP-1000	3750	1250	1000	SNPC	WH	2009-9		
CHINA	CN -25	HAIYANG 2	PWR	AP-1000	3750	1250	1000	SNPC	WH	2010-6		
CHINA	CN -20	HONGYANHE 1	PWR	CPR-1000	2905	1080	1000	LHNPC	DFEC	2007-8		
CHINA	CN -21	HONGYANHE 2	PWR	CPR-1000	2905	1080	1000	LHNPC	DFEC	2008-3		
CHINA	CN -22	HONGYANHE 3	PWR	CPR-1000	2905	1080	1000	LHNPC	DFEC	2009-3		
CHINA	CN -23	HONGYANHE 4	PWR	CPR-1000	2905	1080	1000	LHNPC	DFEC	2009-8		
CHINA	CN -13	LINGAO 4	PWR	CPR1000	2905	1080	1000	LDNPC	DFEC	2006-6	2011-2	2011-5
CHINA	CN -36	NINGDE 1	PWR	CPR1000	2905	1087	1000	NDNPC	DFEC	2008-2		
CHINA	CN -37	NINGDE 2	PWR	CPR1000	2905	1080	1000	NDNPC	DFEC	2008-11		
CHINA	CN -38	NINGDE 3	PWR	CPR1000	2905	1080	1000	NDNPC	DFEC	2010-1		
CHINA	CN -39	NINGDE 4	PWR	CPR1000	2905	1080	1000	NDNPC	DFEC	2010-9		
CHINA	CN -15	QINSHAN 2-4	PWR	CNP 600	1930	650	610	NPQJVC	CNNC	2007-1	2011-12	2012-3

FIG. 4-23. Table 13 Report.

Condition:

- When generated for the current year, the report includes all reactors that are currently in "under construction" status.
- For any year in the past, the report includes reactors in status "under construction", "operational", "long-term shutdown" and "permanent shutdown", for which construction started in or before the reporting year and were not yet connected to the grid in the reporting year.
- Net electrical capacity [MW] is the design net electrical capacity from the Reactor table or, if unavailable, the latest net electrical capacity from the Reactor table.

Data Selection:

- All data for this report is selected from the Reactor table.

4.3.14. Operational Reactors (Table 14)

This report lists all reactors that are in operation in the reporting year with basic design information as well as performance indicators (EAF, UCF) for the past decade.

Reactors in operation

Latest in 2010

Country	Reactor		Type	Model	Capacity [MW]			Operator	NSSS Supplier	Const. Start	Grid Connection	Comm. Operation	EAF %	UCF %
	Code	Name			Thermal	Gross	Net						2000 - 2010	2000 - 2010
ARGENTINA	AR -1	ATUCHA-1	PHWR	PHWR KWU	1179	357	335	NASA	SIEMENS	1968-6	1974-3	1974-6	72.7	73.9
ARGENTINA	AR -2	EMBALSE	PHWR	CANDU 6	2015	648	600	NASA	AECL	1974-4	1983-4	1984-1	86.7	87.1
ARMENIA	AM -19	ARMENIA-2	PWR	VVER V-270	1375	408	375	ANPPJSC	FAEA	1975-7	1980-1	1980-5	65	67
BELGIUM	BE -2	DOEL-1	PWR	WE (2 loops)	1311	454	433	ELECTRAB	ACECOWEN	1969-7	1974-8	1975-2	85.2	86.1
BELGIUM	BE -4	DOEL-2	PWR	WE (2 loops)	1311	454	433	ELECTRAB	ACECOWEN	1971-9	1975-8	1975-12	81.9	82.7
BELGIUM	BE -5	DOEL-3	PWR	WE 3-loops	3054	1056	1006	ELECTRAB	FRAMACEC	1975-1	1982-6	1982-10	86.1	87.5
BELGIUM	BE -7	DOEL-4	PWR	WE 3-loops	2988	1090	1038	ELECTRAB	ACECOWEN	1978-12	1985-4	1985-7	83.8	84.5
BELGIUM	BE -3	TIHANGE-1	PWR	Framatome 3 lo	2873	1009	962	ELECTRAB	ACLF	1970-6	1975-3	1975-10	84	86.4
BELGIUM	BE -6	TIHANGE-2	PWR	WE 3-loops	3064	1055	1008	ELECTRAB	FRAMACEC	1976-4	1982-10	1983-6	87.9	88.9
BELGIUM	BE -8	TIHANGE-3	PWR	WE 3-loops	3000	1094	1046	ELECTRAB	ACECOWEN	1978-11	1985-6	1985-9	87.4	89
BRAZIL	BR -1	ANGRA-1	PWR	2-loop WE	1882	640	609	ELETRONU	WH	1971-5	1982-4	1985-1	54.3	61.1
BRAZIL	BR -2	ANGRA-2	PWR	PRE KONVOI	3764	1350	1275	ELETRONU	KWU	1976-1	2000-7	2001-2	83.9	85.6
BULGARIA	BG -5	KOZLODUY-5	PWR	VVER V-320	3000	1000	953	KOZNPP	AEE	1980-7	1987-11	1988-12	65.7	68.6
BULGARIA	BG -6	KOZLODUY-6	PWR	VVER V-320	3000	1000	953	KOZNPP	AEE	1982-4	1991-8	1993-12	72.9	75.4
CANADA	CA -10	BRUCE-3	PHWR	CANDU 750A	2832	805	730	BRUCEPOW	NEI.P	1972-7	1977-12	1978-2	73	73.8
CANADA	CA -11	BRUCE-4	PHWR	CANDU 750A	2832	805	730	BRUCEPOW	NEI.P	1972-9	1978-12	1979-1	72	72.9
CANADA	CA -18	BRUCE-5	PHWR	CANDU 750B	2832	872	817	BRUCEPOW	OH/AECL	1978-6	1984-12	1985-3	84.4	85
CANADA	CA -19	BRUCE-6	PHWR	CANDU 750B	2690	891	817	BRUCEPOW	OH/AECL	1978-1	1984-6	1984-9	80.8	81.5
CANADA	CA -20	BRUCE-7	PHWR	CANDU 750B	2832	872	817	BRUCEPOW	OH/AECL	1979-5	1986-2	1986-4	84.7	85.6
CANADA	CA -21	BRUCE-8	PHWR	CANDU 750B	2690	845	782	BRUCEPOW	OH/AECL	1979-8	1987-3	1987-5	82.9	84.1
CANADA	CA -22	DARLINGTON-1	PHWR	CANDU 850	2776	934	878	OPG	OH/AECL	1982-4	1990-12	1992-11	84.5	85.5
CANADA	CA -23	DARLINGTON-2	PHWR	CANDU 850	2776	934	878	OPG	OH/AECL	1981-9	1990-1	1990-10	77.4	78.4
CANADA	CA -24	DARLINGTON-3	PHWR	CANDU 850	2776	934	878	OPG	OH/AECL	1984-9	1992-12	1993-2	85.7	86.6
CANADA	CA -25	DARLINGTON-4	PHWR	CANDU 850	2776	934	878	OPG	OH/AECL	1985-7	1993-4	1993-6	85.1	85.8
CANADA	CA -12	GENTILLY-2	PHWR	CANDU 6	2156	675	635	HQ	AECL	1974-4	1982-12	1983-10	80.2	82.1
CANADA	CA -4	PICKERING-1	PHWR	CANDU 500A	1744	542	515	OPG	OH/AECL	1966-6	1971-4	1971-7	65.8	65.9
CANADA	CA -7	PICKERING-4	PHWR	CANDU 500A	1744	542	515	OPG	OH/AECL	1968-5	1973-5	1973-6	65.7	66
CANADA	CA -13	PICKERING-5	PHWR	CANDU 500B	1744	540	516	OPG	OH/AECL	1974-11	1982-12	1983-5	73.7	74.2

FIG. 4-24. Table 14 Report.

Condition:

- When generated for the current calendar year, the report includes all reactors that are currently in "operational" status.
- When generated in a past year, the report includes all reactors that were in commercial operation for at least one day during the year concerned. The following criteria are applied:
    - The reactor is currently in "operational", "long-term shutdown" or "permanent shutdown" status.
    - The reporting year is between the reactor's commercial date (inclusive) and shutdown date (exclusive).
    - The reactor is not in long-term shutdown in December of the reporting year.
- Net electrical capacity is the reactor unit's capacity in the reporting year, calculated from monthly production data.
- Performance indicators are calculated from monthly production data for a selected number of years. Only operational (excluding long-term shutdowns) months are considered. The 15 day condition for borderline months is applied.

Data Selection:

- All reactor related columns are selected from the Reactor table, except for net electrical capacity.
- Net electrical capacity is selected from Annual Electricity Reconstruction; if no value is available, the latest net electrical capacity from the Reactor table is used.
- Performance indicator values rely on data in the Monthly Production table.

4.3.15. Reactors in Long-Term Shutdown (Table 15)

This report lists all reactors that are in long-term shutdown at the end of the reporting year.

Long-term shutdown reactors

Latest in 2010

Country	Reactor		Type	Model	Capacity [MW]			Operator	NSSS	Construction	Grid	Commercial
	Code	Name			Thermal	Gross	Net		Supplier	start	connection	operation
CANADA	CA -8	BRUCE-1	PHWR	CANDU 791	2832	824	848	BRUCEPOW	OH/AECL	1971-6	1977-1	1977-9
CANADA	CA -9	BRUCE-2	PHWR	CANDU 791	2832	824	848	BRUCEPOW	OH/AECL	1970-12	1976-9	1977-9
CANADA	CA -5	PICKERING-2	PHWR	CANDU 500A	1744	542	515	OPG	OH/AECL	1966-9	1971-10	1971-12
CANADA	CA -6	PICKERING-3	PHWR	CANDU 500A	1744	542	515	OPG	OH/AECL	1967-12	1972-5	1972-6
JAPAN	JP -31	MONJU	FBR	Not specified	714	280	246	JAEA	T/H/F/M	1986-5	1995-8	
WORLDWIDE	Long term shutdown reactors:		5		Total Net Capacity:		2972	[MW]				

FIG. 4-25. Table 15 Report.

Condition:

- This report includes all reactors that are in long-term shutdown (LTS) at the end of the reporting year.
- The report includes reactors in “operational”, “long-term shutdown” and “permanent shutdown” status. LTS date is in or before the reporting year and LTS restart date is not in the reporting year.
- Net electrical capacity is the net electrical capacity in the month before the long-term shutdown date.

Data Selection:

- Net electrical capacity before the LTS is selected from the Monthly Production table, if a record for the month before the LTS is available. Otherwise, the latest net electrical capacity recorded in the Reactor table is used.

4.3.16. Reactors in Permanent Shutdown (Table 16)

This report lists all reactors that are in permanent shutdown at the end of the reporting year. The results are grouped by country.

Reactors in Permanent Shutdown

Latest in 2010

Country	Ref. no.	Reactor Unit	Type	Capacity [MW] Thermal	Gross	Net	Operator	NSSS Supplier	Construction start	Grid connection	Commercial operation	Shutdown	Totals
ARMENIA													1
	AM -18	ARMENIA-1	PWR	1375	408	376	ANPPJSC	FAEA	1969-7	1976-12	1977-10	1989-2	
BELGIUM													1
	BE -1	BR-3	PWR	41	12	10	CEN/SCK	WH	1957-11	1962-10	1962-10	1987-6	
BULGARIA													4
	BG -1	KOZLODUY-1	PWR	1375	440	408	KOZNPP	AEE	1970-4	1974-7	1974-10	2002-12	
	BG -2	KOZLODUY-2	PWR	1375	440	408	KOZNPP	AEE	1970-4	1975-8	1975-11	2002-12	
	BG -3	KOZLODUY-3	PWR	1375	440	408	KOZNPP	AEE	1973-10	1980-12	1981-1	2006-12	
	BG -4	KOZLODUY-4	PWR	1375	440	408	KOZNPP	AEE	1973-10	1982-5	1982-6	2006-12	
CANADA													3
	CA -2	DOUGLAS POINT	PHWR	704	218	206	OH	AECL	1960-2	1967-1	1968-9	1984-5	
	CA -3	GENTILLY-1	HWLWR	792	266	250	HQ	AECL	1966-9	1971-4	1972-5	1977-6	
	CA -1	ROLPHTON NPD	PHWR	92	25	22	OH	CGE	1958-1	1962-6	1962-10	1987-8	
FRANCE													12
	FR -9	BUGEY-1	GCR	1954	555	540	EDF	FRAM	1965-12	1972-4	1972-7	1994-5	
	FR -2	CHINON-A1	GCR	300	80	70	EDF	LEVIVIER	1957-2	1963-6	1964-2	1973-4	
	FR -3	CHINON-A2	GCR	800	230	180	EDF	LEVIVIER	1959-8	1965-2	1965-2	1985-6	
	FR -4	CHINON-A3	GCR	1170	480	360	EDF	GTM	1961-3	1966-8	1966-8	1990-6	
	FR -5	CHOOZ-A (ARDENNES)	PWR	1040	320	305	SENA	A/F/W	1962-1	1967-4	1967-4	1991-10	
	FR -6	EL-4 (MONTS D'ARREE)	HWGCR	250	75	70	EDF	GAAA	1962-7	1967-7	1968-6	1985-7	
	FR -1B	G-2 (MARCOULE)	GCR	260	43	39	COGEMA	SACM	1955-3	1959-4	1959-4	1980-2	
	FR -1	G-3 (MARCOULE)	GCR	260	43	40	COGEMA	SACM	1956-3	1960-4	1960-4	1984-6	
	FR -10	PHENIX	FBR	345	142	130	CEA/EDF	CNCLNEY	1968-11	1973-12	1974-7	2010-2	
	FR -7	ST. LAURENT-A1	GCR	1650	500	390	EDF	FRAM	1963-10	1969-3	1969-6	1990-4	
	FR -8	ST. LAURENT-A2	GCR	1475	530	465	EDF	FRAM	1966-1	1971-8	1971-11	1992-5	
	FR -24	SUPER-PHENIX	FBR	3000	1242	1200	EDF	ASPALDO	1976-12	1986-1	1986-12	1998-12	
GERMANY													19
	DE -4	AVR JUELICH (AVR)	HTGR	46	15	13	AVR	BBK	1961-8	1967-12	1969-5	1988-12	

FIG. 4-26. Table 16 Report.

Condition:

- The report lists all reactors in "shutdown" status that shut down in or before the reporting year.
- Net Capacity is understood to be the net electrical capacity in the last month the reactor was operational i.e. the month preceding the permanent shutdown date.

Data Selection:

- All information except for net electrical capacity [MW] is selected from the Reactor table.
- Net electrical capacity before the permanent shutdown is selected from the Monthly Production table, if a record for the month before the shutdown is available. Otherwise, the latest net electrical capacity recorded in the Reactor table is used.

4.3.17. Decommissioning Process/decommissioned (Table 17)

This report provides information on all reactors that are in the decommissioning process or that have been already decommissioned. For each reactor the following results are grouped by country: shutdown date, shutdown reason, decommissioning strategy, current decommissioning phase, current fuel management phase, decommissioning licensee and decommissioning license termination.

The table is complete with a legend of decommissioning process terms.

Reactors in Decommissioning process or Decommissioned

Country	Ref. no.	Reactor Unit	Shutdown	Shutdown reason	Decom. strategy	Current decom. phase	Current fuel managemt phase	Decom. licensee	License terminated	Totals
ARMENIA										1
	AM -18	ARMENIA-1	1989-2	Others	Other			ANPPJSC		
BELGIUM										1
	BE -1	BR-3	1987-6	2,5	Imdte.dism.	4,9	4	CEN/SCK		
BULGARIA										4
	BG -1	KOZLODUY-1	2002-12	7,Others	Dd+PD+SE	6,7	3,6,7	E-03492	2036	
	BG -2	KOZLODUY-2	2002-12	7,Others	Dd+PD+SE	6,7	3,6,7	E-03493	2036	
	BG -3	KOZLODUY-3	2006-12	7,Others	Dd+PD+SE	7	2,6,7	E-00174	2036	
	BG -4	KOZLODUY-4	2006-12	7,Others	Dd+PD+SE	7	2,7	E-0008	2036	
CANADA										3
	CA -1	ROLPHTON NPD	1987-8	2	Dd+PD+SE	8		AECL		
	CA -2	DOUGLAS POINT	1984-5	2	Dd+SE	8	7	AECL		
	CA -3	GENTILLY-1	1977-6	2	Dd+PD+SE	8	7	AECL		
FRANCE										10
	FR -10	PHENIX	2010-2	Others	Imdte.dism.			-		
	FR -2	CHINON-A1	1973-4	1,2	Imdte.dism.			EDF		
	FR -24	SUPER-PHENIX	1998-12	Others	Imdte.dism.	6	3,6	NERSA		
	FR -3	CHINON-A2	1985-6	1,2	Imdte.dism.			EDF	2025	
	FR -4	CHINON-A3	1990-6	1,2	Imdte.dism.			EDF		
	FR -5	CHOOZ-A (ARDENNES)	1991-10	Others	Imdte.dism.	4,9		SENA	2019	
	FR -6	EL-4 (MONTS D'ARREE)	1985-7	1,2	Imdte.dism.	9		EDF	2015	
	FR -7	ST. LAURENT-A1	1990-4	1,2	Imdte.dism.			EDF	2027	
	FR -8	ST. LAURENT-A2	1992-5	1,2	Imdte.dism.			EDF	2025	
	FR -9	BUGEY-1	1994-5	1,2	Imdte.dism.	9		EDF	2020	
GERMANY										11
	DE -10	STADE (KKS)	2003-11	2	Imdte.dism.	3,4,6		E.ON	2014	
	DE -3	GUNDREMMINGEN-A (KRB A)	1977-1	6,8	Imdte.dism.			KGG		
	DE -4	AVR JUELICH (AVR)	1988-12	7	Imdte.dism.	3,4,9		xxxx		

FIG. 4-27. Table 17 Report.

Condition:

- The report includes reactor units that have been shutdown in or before the reporting year and have decommissioning information published.

Data Selection:

- Information for this report is extracted from the Reactor table as well as the decommissioning tables in PRIS.

4.3.18. Performance Indicators (Table 18)

This report presents average performance indicators by reactor category for the three year period up to the reporting year.

The performance indicators included are:

- Energy availability factor (EAF);
- Planned Capability Loss Factor (PCL);
- Unit Capability Factor (UCF);
- Forced Loss Rate (FLR);
- Operating Factor (OF);
- Load Factor (LF).

Performance factors by reactor category, 2008 to 2010

Reactor category	Reactors reporting to IAEA PRIS (see note)						
	Number of Units	Availability Factor (EAF) %	Planned Cap.Loss Factor (PCL) %	Capacity Factor(UCF) %	Forced Loss Rate (FLR) %	Operating Factor (OF) %	Load Factor(LF) %
PWR	269	83.30	11.30	84.40	3.00	84.60	82.60
PWR < 600 MWe	47	84.30	13.90	84.60	1.50	85.10	82.90
PWR >= 600 MWe	222	83.20	11.00	84.30	3.10	84.60	82.60
BWR	94	74.70	18.00	75.20	6.00	76.30	74.20
BWR < 600 MWe	12	68.00	25.20	68.30	6.80	71.60	68.10
BWR >= 600 MWe	82	75.00	17.60	75.60	6.00	76.90	74.50
PHWR	46	75.70	14.20	80.50	5.20	76.60	75.00
PHWR < 600 MWe	26	58.40	19.30	71.40	10.90	69.70	56.80
PHWR >= 600 MWe	20	84.80	11.50	85.30	2.50	85.10	84.60
LWGR	16	78.50	18.10	78.80	2.30	77.20	78.30
LWGR < 600 MWe	4	72.00	27.00	72.00	0.20	69.00	32.80
LWGR >= 600 MWe	12	78.50	18.00	78.80	2.30	80.00	78.50
GCR	18	61.40	13.00	61.60	19.00	68.90	61.50
FBR	2	70.40	27.70	70.50	1.60	61.70	70.70
TOTAL	**445**	**80.20**	**13.20**	**81.30**	**4.10**	**81.00**	**79.60**

FIG. 4-28. Table 18 Report.

Condition:

- When the report is generated for the current calendar year, it includes all reactors that are currently in "operational" status.
- When generated for a past year, the report includes all reactors that are in commercial operation for at least one day during the three year reporting period. The following criteria are applied:
  - The reactor is currently in "operational", "long-term shutdown" or "permanent shutdown" status.
  - The reporting year is ≥the reactor's commercial date.
  - The shutdown date is ≥ the first year of the three year reporting period.
  - The reactor is not in long-term shutdown in December of the reporting year.
- Reactors are divided into categories according to their reactor type (PWR, BWR, PHWR, LWGR, GCR, and FBR) and their capacity (< 600 MWe, ≥ 600 MWe and all of them).
- To split reactors into categories according to their net electrical capacity, the capacity in the last year of the reporting period is used. In absence of the relevant value, the latest capacity from the Reactor table is used.
- Performance indicators are calculated from monthly production data. Only months that a reactor was in commercial operation are considered i.e. months from the reactor's commercial date to its shutdown date, excluding periods of long-term shutdown and applying the 15 day condition.
- The performance indicator values are weighted averages, weighted by reactor unit capacity and the number of months in operation during the reporting period for each reactor.

4.3.19. Full Outage Statistics (Table 19)

This report provides statistics about full outages, i.e. outages causing reactor units to be disconnected from the grid. The distribution percentage of planned, unplanned and external full outages is provided per reactor category, along with the total number of full outage hours per operating experience year.

Full Outage Statistics

Latest in 2010

Reactor Type	Number of Units	Full Outage Hours per Operating Experience Year	% Planned Outages	% Unplanned Outages	% External Outages
PWR	268	1302	73.00	24.10	2.90
PWR < 600 MWe	46	1167	89.20	9.20	1.60
PWR >= 600 MWe	222	1331	70.00	26.80	3.20
BWR	92	1892	66.80	31.50	1.70
BWR < 600 MWe	11	2052	54.90	45.00	0.10
BWR >= 600 MWe	81	1871	68.60	29.50	1.90
PHWR	46	1956	78.40	21.40	0.20
PHWR < 600 MWe	26	2410	78.20	21.60	0.20
PHWR >= 600 MWe	20	1366	78.90	20.80	0.30
LWGR	15	2063	88.70	7.70	3.60
LWGR < 600 MWe	4	3155	91.80	0.80	7.40
LWGR >= 600 MWe	11	1665	86.50	12.40	1.10
GCR	18	2146	29.60	69.30	1.10
FBR	1	2219	100.00	0.00	0.00
ALL REACTORS	**440**	**1557**	**70.50**	**27.40**	**2.10**

FIG. 4-29. Table 19 Report.

Condition:

- When generated for the current calendar year, the report includes all reactors that are currently in "operational" status.
- When generated in a past year, the report includes all reactors that are in commercial operation in the reporting year, according to the following criteria:
    - The reactor is currently in "operational", "long-term shutdown" or "permanent shutdown" status.
    - The reactor started commercial operation before or in the reporting year.
    - If the reactor is currently shutdown, the year of the shutdown is past the reporting year.
    - The reactor was not in long-term shutdown in December of the reporting year.
- Reactors are split into categories following the same criteria as in Table 18.
- The full outage hours per operating experience year are calculated as the ratio of full outage hours of all reactors in a category to the number of reactors in that category. The exact number of months each reactor was operational during the reporting year is not taken into account.
- The report considers all full outages that started in the reporting year. Note: This may include outages during a reactor's trial period or during a long-term shutdown.
- All full outages that are coded anything but "planned (P) or unplanned (U)" are considered to be external.

Data Selection:

- All outage data is selected from the Outages table. The outage type code is used for outage breakdown.

- The Annual Electricity Reconstruction and/or Reactor tables are used to determine the net electrical capacity of reactors that are used for reactor classification.

4.3.20. Direct Causes of Full Outages – Annual (Table 20)

This report examines the direct causes of planned and unplanned full outages in a selected reporting year. Energy loss [GWh] and operating hours lost are calculated for each outage cause in absolute numbers and percentages.

Direct causes of full outages

Latest in 2010

	Planned Full Outages				Unplanned Full Outages			
Direct Outage Cause	Energy Lost		Time Lost		Energy Lost		Time Lost	
	GW(e).h	%	Hours	%	GW(e).h	%	Hours	%
Plant equipment problem/failure					118668	74.58	138785	74.02
Refuelling without a maintenance	17861	4.57	17587	3.64				
Inspection, maintenance or repair combined with refuelling	287995	73.74	331197	68.50				
Inspection, maintenance or repair without refuelling	24962	6.39	44658	9.24				
Testing of plant systems or components	485	0.12	7084	1.47	124	0.08	249	0.13
Major back-fitting, refurbishment or upgrading activities with refuelling	12741	3.26	27444	5.68				
Major back-fitting, refurbishment or upgrading activities without refuelling	45740	11.71	46770	9.67				
Nuclear regulatory requirements					19895	12.50	25401	13.55
Human factor related					6649	4.18	8646	4.61
Fire					1523	0.96	2397	1.28
Fuel management limitation (including high flux tilt, stretch out or coast-down operation)					1807	1.14	1804	0.96
Others	790	0.20	8762	1.81	10444	6.56	10215	5.45
TOTAL	**390574**	**100.00**	**483502**	**100.00**	**159110**	**100.00**	**187497**	**100.00**

FIG. 4-30. Table 20 Report.

Condition:

- The report only considers planned and unplanned full outages (outages codes PF and UF).
- The report calculates the total energy and time lost for planned and unplanned full outages during the reporting year. In addition, it presents the percentage distribution of energy and time lost due to the different outage causes.
- The report considers reactors that are in operation in the reporting period, according to the following rules:
    - The reactor unit is connected to the grid within or before the reporting year.
    - If the reactor is shut down, it was shut down within or after the reporting year.
- The report considers outages starting from the month of a reactor's commercial date. These may include outages that occur in the days of trial operations preceding the actual commercial date.
- The report does not filter outages on the long-term shutdown date, restart date or permanent shutdown date. If an error is made and outages have been entered for long-term shutdowns or after a reactor's permanent shutdown, they would be taken into account.

Data Selection:

- Outage information (duration, energy loss, cause) is selected from the Outages table and the Cause table.
- The Reactor table is used for filtering purposes.

4.3.21. Direct Causes of Full Outages – Total (Table 21)

This report examines the direct causes of planned and unplanned full outages from 2009 to the current reporting year. Energy loss [GWh] and operating hours lost are calculated for each outage cause, in absolute numbers as well as a percentage.

Direct causes of full outages, 2009 to 2010

Direct Outage Cause	Planned Full Outages				Unplanned Full Outages			
	Energy Lost		Time Lost		Energy Lost		Time Lost	
	GW(e).h	%	Hours	%	GW(e).h	%	Hours	%
Plant equipment problem/failure					234804	74.20	262560	73.57
Refuelling without a maintenance	31050	3.79	32383	3.15	86	0.03	144	0.04
Inspection, maintenance or repair combined with refuelling	573338	70.03	675087	65.68	4291	1.36	7313	2.05
Inspection, maintenance or repair without refuelling	47274	5.77	85197	8.29				
Testing of plant systems or components	1377	0.17	12928	1.26	171	0.05	412	0.12
Major back-fitting, refurbishment or upgrading activities with refuelling	53983	6.59	89841	8.74	1681	0.53	2064	0.58
Major back-fitting, refurbishment or upgrading activities without refuelling	110330	13.48	120925	11.76				
Nuclear regulatory requirements					35196	11.12	41184	11.54
Human factor related					8075	2.55	9958	2.79
Environmental conditions (lack of cooling water due to dry weather, cooling water temperature limits, flood, storm, lightning, etc.)					1057	0.33	1001	0.28
Fire					2123	0.67	3462	0.97
External restrictions on supply and services (lack of funds due to delayed payments from customers, disputes in fuel industries, fuel-rationing, labour strike outside the plant , spare part delivery problems etc.)	381	0.05	1909	0.19	1920	0.61	1898	0.53
Fuel management limitation (including high flux tilt, stretch out or coast-down operation)	166	0.02	843	0.08	1807	0.57	1804	0.51
Others	790	0.10	8762	0.85	25221	7.97	25065	7.02
TOTALS	**818689**	**100.00**	**1027875**	**100.00**	**316432**	**100.00**	**356865**	**100.00**

FIG. 4-31. Table 21 Report.

Condition:

- The report only considers planned and unplanned full outages (outages codes PF and UF).
- The report calculates the total energy and time lost for planned and unplanned full outages during the two year reporting period. In addition, it presents the percentage distribution of energy and time lost due to the different outage causes.
- The report is year-based. Outages are included if they start in the reporting period.
- The report considers reactor units in operation, in long-term shutdown and permanent shutdown that were connected to the grid on or before the reporting year.
- The report considers outages starting from the year of a reactor's commercial date. This may include outages that occurred in the months of trial operation preceding the actual commercial date.
- The report does not filter outages on long-term shutdown date, restart date or permanent shutdown date.

Data Selection:

- Outage information (duration, energy loss, cause) is selected from the Outages table and the Cause table.
- The Reactor table is used for filtering purposes.

4.3.22. Countries Summary (Table 22)

For each country, this report provides the number of reactors under construction, in operation, in long-term shutdown and in permanent shutdown at the end of the reporting year.

Countries - Abbreviations and Summaries

Latest in 2010

Iso Code	Country	Under construction	Operational	Long term shutdown	Shutdown
AM	ARMENIA	0	1	0	1
AR	ARGENTINA	1	2	0	0
BE	BELGIUM	0	7	0	1
BG	BULGARIA	2	2	0	4
BR	BRAZIL	1	2	0	0
CA	CANADA	0	18	4	3
CH	SWITZERLAND	0	5	0	1
CN	CHINA	29	13	0	0
CZ	CZECH REPUBLIC	0	6	0	0
DE	GERMANY	0	17	0	19
ES	SPAIN	0	8	0	2
FI	FINLAND	1	4	0	0
FR	FRANCE	1	58	0	12
GB	UNITED KINGDOM	0	19	0	26
HU	HUNGARY	0	4	0	0
IN	INDIA	6	19	0	0
IR	IRAN, ISLAMIC REPUBLIC OF	1	0	0	0
IT	ITALY	0	0	0	4
JP	JAPAN	2	54	1	5
KR	KOREA, REPUBLIC OF	5	21	0	0
KZ	KAZAKHSTAN	0	0	0	1
LT	LITHUANIA, REPUBLIC OF	0	0	0	2
MX	MEXICO	0	2	0	0
NL	NETHERLANDS	0	1	0	1
PK	PAKISTAN	1	2	0	0
RO	ROMANIA	0	2	0	0
RU	RUSSIAN FEDERATION	11	32	0	5
SE	SWEDEN	0	10	0	3
SI	SLOVENIA	0	1	0	0

FIG. 4-32. Table 22 Report.

Condition:

- When generated for the current year, the report counts reactors according to their current status.
- When generated for a year in the past, the following rules are applied:
  - Under construction:
    - The reactor is currently in any status (planned, under construction, operational, long-term shutdown, or permanent shutdown).
    - Construction for the reactor has started before or during the reporting year.
    - The reactor unit was not connected to the grid in December of the reporting year.
  - Operational:
    - The reactor is currently in any status (planned, under construction, operational, long-term shutdown, or permanent shutdown).
    - The reactor unit is connected to the grid before or within the reporting year.
    - The reactor is not shutdown by December of the reporting year.
    - The reactor is not in long-term shutdown by December of the reporting year.
  - Long-term shutdown:

        - The reactor is currently operational, in long-term shutdown or in permanent shutdown.
        - The reactor unit is connected to the grid before or during the reporting year.
        - The reactor is not permanently shutdown in the reporting year.
        - The reactor is in long-term shutdown by December of the reporting year.
    - Permanent shutdown:
        - The reactor is in operational, long-term shutdown or permanent shutdown status.
        - The reactor is shutdown before or during the current reporting year.
        - The reactor unit is connected to the grid before or during the reporting year.

Data Selection:

- The dates used to determine the (historical) status of a reactor in the reporting year are selected from the Reactor and Long-term Shutdown Details tables.
- Country information is selected from the Country table.

4.3.23. Reactor Type Summary (Table 23)

For each reactor type, this report provides the number of reactors under construction, in operation, in long-term shutdown and in permanent shutdown at the end of the reporting year.

Reactor Types - Abbreviations and Summaries

Latest in 2010

Type Code	Type	Under construction	Operational	Long term shutdown	Shutdown
BWR	Boiling Light-Water-Cooled and Moderated Reactor	4	92	0	23
FBR	Fast Breeder Reactor	3	1	1	7
GCR	Gas-Cooled, Graphite-Moderated Reactor	0	18	0	34
HTGR	High-Temperature Gas-Cooled, Graphite-Moderated Reactor	0	0	0	4
HWGCR	Heavy-Water-Moderated, Gas-Cooled Reactor	0	0	0	4
HWLWR	Heavy-Water-Moderated, Boiling Light-Water-Cooled Reactor	0	0	0	2
LWGR	Light-Water-Cooled, Graphite-Moderated Reactor	1	15	0	9
PHWR	Pressurized Heavy-Water-Moderated and Cooled Reactor	4	46	4	5
PWR	Pressurized Light-Water-Moderated and Cooled Reactor	56	269	0	34
SGHWR	Steam-Generating Heavy-Water Reactor	0	0	0	1
X	Others	0	0	0	2
WORLDWIDE		**68**	**441**	**5**	**125**

FIG. 4-33. Table 23 Report.

Condition:

- When generated for the current year, the report counts reactors according to their current status.
- When generated for a past year, the following rules are applied:
    - Under construction:

        - The reactor is currently in any main status (planned, under construction, operational, long-term shutdown, or permanent shutdown).
        - Construction for the reactor has started before or during the reporting year.
        - The reactor unit is not connected to the grid by December of the reporting year.
    - Operational:
        - The reactor is currently in any main status (planned, under construction, operational, long-term shutdown, or permanent shutdown).
        - The reactor unit is connected to the grid before or during the reporting year.
        - The reactor is not shutdown by December of the reporting year.
        - The reactor is not in long-term shutdown by December of the reporting year.
    - Long-term shutdown:
        - The reactor is currently operational, in long-term shutdown or in permanent shutdown.
        - The reactor unit is connected to the grid before or during the reporting year.
        - The reactor is not permanently shutdown in the reporting year.
        - The reactor is in long-term shutdown by December of the reporting year.
    - Permanent shutdown:
        - The reactor is now in operational, long-term shutdown or permanent shutdown status.
        - The reactor is shutdown before or during the reporting year.
        - The reactor unit is connected to the grid before or during the reporting year.

Data Selection:

- The dates used to determine the (historical) status of a reactor in the reporting year are selected from the Reactor and Long-term Shutdown Details tables.
- Reactor type information (description) is selected from the Type table.

4.3.24. Operator Summary (Table 24)

For each reactor operator, this report provides the number of reactors under construction, in operation, in long-term shutdown and in permanent shutdown, at the end of the reporting year.

Operators - Abbreviations and Summaries

Latest in 2010

Operator Code	Full Name	Under construction	Operational	Long term shutdown	Shutdown
AEC/NPPD	Atomic Energy Commission and Nebraska Public Power District	0	0	0	1
AEP	American Electric Power Company, Inc.	0	2	0	0
AmerenUE	AMEREN UE, Union Electric Company	0	1	0	0
ANAV	ASOCIACION NUCLEAR ASCO-VANDELLOS A.I.E. (ENDESA/ID)	0	3	0	0
ANPPJSC	Joint Stock Company Armenian NPP	0	1	0	1
APS	ARIZONA PUBLIC SERVICE CO.	0	3	0	0
AVR	ARBEITSGEMEINSCHAFT VERSUCHSREAKTOR GMBH	0	0	0	1
Axpo AG	Kernkraftwerk Beznau CH-5312 DÃ¶ttingen	0	2	0	0
BE	BRITISH ENERGY	0	15	0	0
BHAVINI	Bharatiya Nabhikiya Vidyut Nigam Limited	1	0	0	0
BKAB	Barsebäck Kraft AB	0	0	0	3
BKW	BKW ENERGIE AG	0	1	0	0
BRUCEPOW	BRUCE POWER	0	6	2	0
BV GKN	BV GEMEENSCHAPPELIJKE KERNENERGIECENTRALE NEDERLAND (BV GKN)	0	0	0	1
CEA/EDF	Commissariat à l'Energie Atomique (80%) Electricité de France (20%)	0	0	0	1
CEN/SCK	CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE / STUDIECENTRUM VOOR KERNENERGIE	0	0	0	1
CEZ	CZECH POWER COMPANY , CEZ a.s.	0	6	0	0

FIG. 4-34. Table 24 Report.

Condition:

- When generated for the current year, the report counts reactors according to their current status.
- When generated for a year in the past, the following rules are applied:
    - Operational:
        - The reactor is currently in any status (planned, under construction, operational, long-term shutdown, or permanent shutdown).
        - The reactor unit is connected to the grid before or during the reporting year.
        - The reactor is not shutdown by December of the reporting year.
        - The reactor is not in long-term shutdown by December of the reporting year.
    - Under construction:
        - The reactor is currently under construction, operational, in long-term shutdown or permanently shut down.
        - Construction for the reactor has started before or during the reporting year.
        - The reactor unit is not connected to the grid by December of the reporting year.
    - Long-term shutdown:
        - The reactor is currently operational, in long-term shutdown or in permanent shutdown.
        - The reactor unit is connected to the grid before or during the reporting year.
        - The reactor is not permanently shutdown in the reporting year.
        - The reactor is in long-term shutdown by December of the reporting year.

- Permanent shutdown:
  - The reactor is now in operational, long-term shutdown or permanent shutdown status.
  - The permanent shutdown date is during the current year and before the reporting year-end.
  - The grid connection date is during the current year or before the reporting year-end.

Data Selection:

- The dates used to determine the (historical) status of a reactor in the reporting year are selected from the Reactor and Long-term Shutdown Details tables.
- Reactor operator information is selected from the Operator table.

4.3.25. Supplier Summary (Table 25)

For each reactor supplier, this report provides the number of reactors under construction, in operation, in long-term shutdown and in permanent shutdown, at the end of the reporting year.

Note: NSSS stands for the Nuclear Steam Supply System.

NSSS Suppliers - Abbreviations and Summaries

Latest in 2010

Supplier Code	Full Name	Under construction	Operational	Long term shutdown	Shutdown
A/F/W	ASSOCIATION ACEC,FRAMATOME ET WESTINGHOUSE.	0	0	0	1
ABBATOM	ABBATOM (formerly ASEA-ATOM)	0	7	0	2
AC	ALLIS CHALMERS	0	0	0	3
ACECOWEN	ACECOWEN (ACEC-COCKERILL-WESTINGHOUSE)	0	4	0	0
ACLF	(ACECOWEN - CREUSOT LOIRE - FRAMATOME)	0	1	0	0
AECL	ATOMIC ENERGY OF CANADA LTD.	0	9	0	2
AECL/DAE	ATOMIC ENERGY OF CANADA Ltda AND DEPARTMENT OF ATOMIC ENERGY(INDIA)	0	1	0	0
AECL/DHI	ATOMIC ENERGY OF CANADA LTD./DOOSAN HEAVY INDUSTRY & CONSTRUCTION	0	3	0	0
AEE	ATOMENERGOEXPORT	0	8	0	6
AEG	ALLGEMEINE ELEKTRICITAETS-GESELLSCHAFT	0	0	0	1
AEG,GE	ALLGEMEINE ELECTRICITAETS-GESELLSCHAFT, GENERAL ELECTRIC COMPANY (US)	0	0	0	1
AEG,KWU	ALLGEMEINE ELEKTRICITAETS GESELLSCHAFT, KRAFTWERK UNION AG	0	0	0	2
AMN/GETS	ANSALDO MECCANICO NUCLEARE SPA / GENERAL ELECTRIC TECHNICAL SERVICES CO	0	0	0	1
APC	ATOMIC POWER CONSTRUCTION LTD.	0	2	0	2
AREVA	AREVA, 27-29, rue Le Peletier, 75433 Paris cedex 09 URL: www.areva.com	4	0	0	0
ASE	ATOMSTROYEXPORT	5	0	0	0
ASEASTAL	ASEA-ATOM / STAL-LAVAL	0	2	0	1
ASPALDO	ASPALDO	0	0	0	1
AtEE	ATOMENERGOEXPORT	0	0	0	6
B&W	BABCOCK & WILCOX CO.	0	7	0	3
BBK	BROWN BOVERI-KRUPP REAKTORBAU GMBH	0	0	0	1

FIG. 4-35. Table 25 Report.

Condition:

- When generated for the current year, the report counts reactors according to their current status.
- When generated for a past year, the following rules are applied:

- Operational:
  - The reactor is currently operational, in long-term shutdown or permanently shut down.
  - The reactor unit is connected to the grid before by the reporting year-end.
  - The reactor is not shutdown by December of the reporting year.
  - The reactor is not in long-term shutdown by December of the reporting year-end.
- Under construction:
  - The reactor is currently under construction, operational, in long-term shutdown or permanently shut down.
  - Construction for the reactor has started before the reporting year-end.
  - The reactor is not operational by the December of the reporting year-end.
- Long-term shutdown:
  - The reactor is in long-term shutdown for at least the entire month of December in the reporting year.
- Permanent shutdown:
  - The reactor is now in operational or permanent shutdown status.
  - The permanent shutdown date is on or before the reporting year-end.

Data Selection:

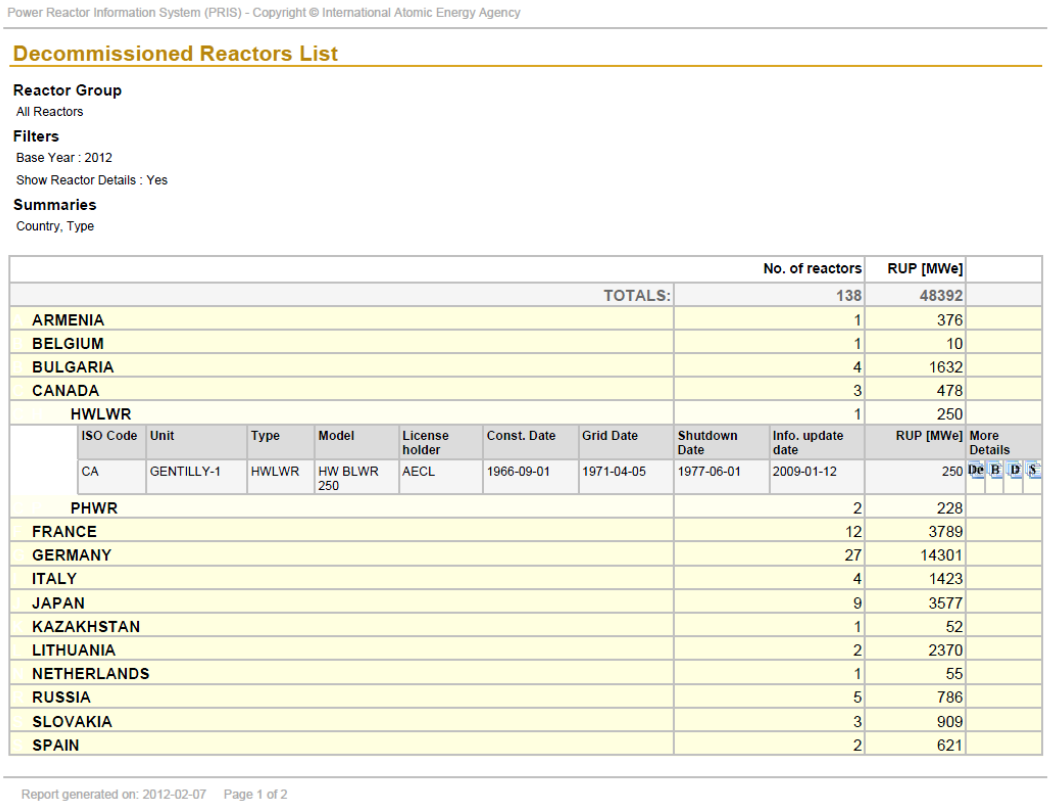
- The dates used to determine the (historical) status of a reactor in the reporting year are selected from the Reactor and Long-term Shutdown Details tables.
- Reactor supplier information is selected from the Contractor table.

4.4. Decommissioning Reports

The reports in this section provide information about reactors that have been permanently shutdown and are currently being decommissioned.

4.4.1. Decommissioned Reactors List

This report lists all reactors that were in permanent shutdown and currently being decommissioned in a year selected by the user.



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Decommissioned Reactors List

Reactor Group
All Reactors

Filters
Base Year : 2012
Show Reactor Details : Yes

Summaries
Country, Type

	No. of reactors	RUP [MWe]
TOTALS:	138	48392
ARMENIA	1	376
BELGIUM	1	10
BULGARIA	4	1632
CANADA	3	478
HWLWR	1	250

ISO Code	Unit	Type	Model	License holder	Const. Date	Grid Date	Shutdown Date	Info. update date	RUP [MWe]	More Details
CA	GENTILLY-1	HWLWR	HW BLWR 250	AECL	1966-09-01	1971-04-05	1977-06-01	2009-01-12	250	De R D S

PHWR	2	228
FRANCE	12	3789
GERMANY	27	14301
ITALY	4	1423
JAPAN	9	3577
KAZAKHSTAN	1	52
LITHUANIA	2	2370
NETHERLANDS	1	55
RUSSIA	5	786
SLOVAKIA	3	909
SPAIN	2	621

Report generated on: 2012-02-07 Page 1 of 2

FIG. 4-36. Decommissioned Reactor Report.

Concept:

- The report provides information about all reactors that were in permanent shutdown in a given year.
- The report has one mandatory parameter: the base year for which the report is being generated. By default, the current year is chosen as the base year.
- Optionally, an age filter can be applied (to reactors in operation, in long-term shutdown or in permanent shutdown) so that only reactors that are a certain age in the base year are considered. Age is calculated from the year of the first grid connection to the year of the permanent shutdown.
- Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, and Age) can be selected. A reactor can only appear in exactly one group in the result set.
- The Show Reactor Details option returns specification data about individual reactors in addition to summary level results. Detailed information about each reactor includes basic design information (i.e. type, model, RUP, etc.), key milestone dates as well as links to the Basic Information, Design Characteristics, Decommissioning Details and Schematics reports.

Condition:

- The report reflects the permanently shutdown reactors at the end of the reporting year. To be included in the report, the reactor's shutdown date needs to be before the end of the base year.
- RUP is the last known net electrical capacity of a reactor unit before its permanent shutdown.

Data Selection:

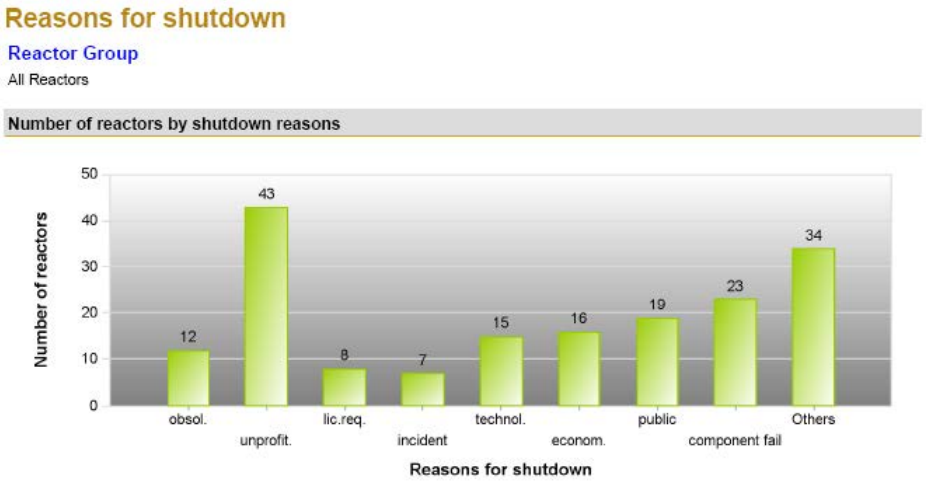
- Reactor detail information is selected from the Reactor, Type and Reactor Decommissioning tables of the PRIS database.
- The selection criteria for this report are the same as for the Year-end Reactor Status report.

4.4.2. Reasons for Shutdown

This report provides shutdown reactors by reason for their shutdown.

The following are a list of reasons for shutdown:

- The technology or process used became obsolete;
- The process was no longer profitable;
- Changes in licensing requirements;
- After an operating incident;
- Other technological reasons;
- Other economic reasons;
- Public acceptance/political reasons;
- After a major component failure or deterioration;
- Other.



Reason	Reason ID	Description
obsol.	1	The technology or process being used became obsolete
unprofit.	2	The process was no longer profitable
lic.req.	3	There were changes in licensing requirements
incident	4	After an operating incident.
technol.	5	Other technological reasons (please mention them below)
econom.	6	Other economical reasons (please mention them below)
public	7	Public Acceptance/Political Reasons
component fail	8	After major component failure or deterioration
Others	undefd	Others (Please specify below. Select "other " only when none of the listed criteria matches the shutdown reason)

FIG. 4-37. Reasons for Shutdown Report.

Concept:

- The report provides a breakdown of shutdown reactors by reasons of their shutdown.
- The report has no mandatory parameters. It always reflects the latest information available.
- If it is generated without reactor details, the report shows a simple bar chart with the number of reactors for each shutdown reason.
- If it is generated with reactor details, the report also lists the reactors concerned by each shutdown reason with the country, name and permanent shutdown date.

Condition:

- The report includes reactors that are in permanent shutdown status with decommissioning information included in the report.
- If no shutdown reason has been provided for a reactor, the reactor is not considered in the report.
- More than one shutdown reason can apply to any particular reactor.

Data Selection:

- Reactor detailed information is selected from the Reactor and Country tables of the PRIS database.
- Decommissioning details are selected from the Reactor Shut Down Reason and Shut Down Reason tables.

4.4.3. Decommissioning Strategies

This report provides shutdown reactors by decommissioning strategy.

The following are a list of decommissioning strategies:

- Deferred dismantling, including partial dismantling and placing remaining radiological areas into safe enclosure.
- Deferred dismantling, placing all radiological areas into safe enclosure.
- Immediate dismantling and removal of all radioactive materials.
- In situ disposal, involving encapsulation of radioactive materials and subsequent restriction of access.
- Other.

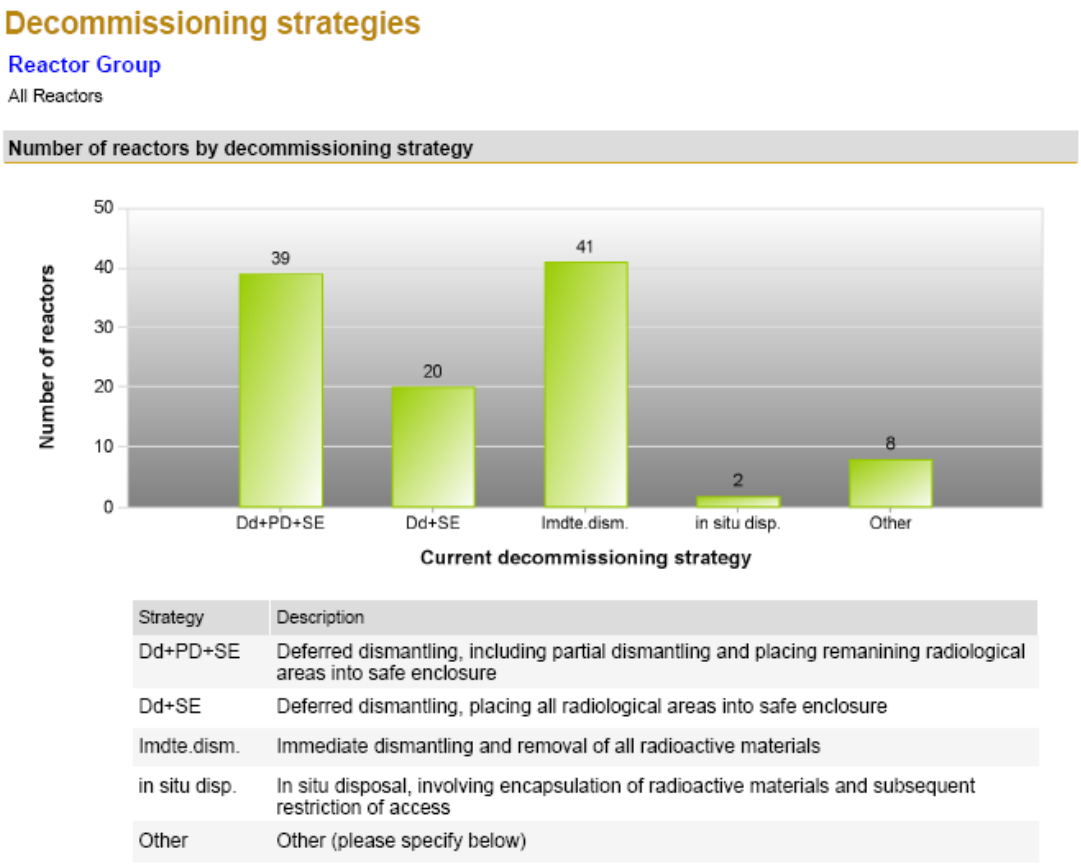


FIG. 4-38. Decommissioning Strategies Report.

Concept:

- The report provides a breakdown of shutdown reactors by decommissioning strategy.
- The report has no mandatory parameters. It reflects the latest information available.
- If it is generated without reactor details, the report shows a simple bar chart with the number of reactors for each decommissioning strategy.
- If it is generated with reactor details, the report lists the reactors concerned by each decommissioning strategy, with their country, name and permanent shutdown date.

Condition:

- The report includes reactors that are in permanent shutdown status and includes decommissioning information that has been entered.
- If no decommissioning strategy has been specified for a reactor, the reactor is not considered by the report.
- Only one decommissioning strategy can be assigned to any given reactor.

Data Selection:

- Reactor detail information is selected from the Reactor and Country tables of the PRIS database.
- Decommissioning details are selected from the Reactor Decom and Decom Strategy tables.

5. ADVANCED REPORTS

Advanced reports allow the extraction of customized data sets and more specific information to support plant performance analyses. The reports are divided into three sections:

– Specification data;
– Operational data;
– Non-electrical application data.

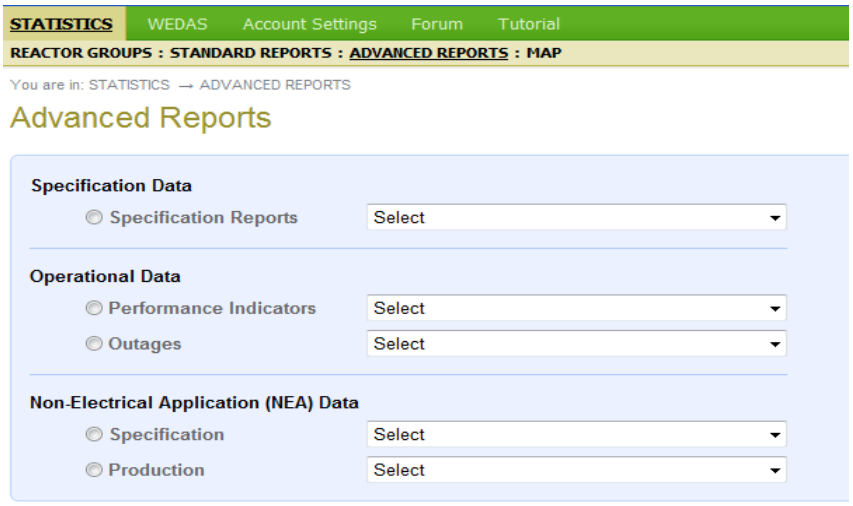


FIG. 5-1. Advanced Reports Selection.

5.1. Specification Data

5.1.1. Specifications Reports – Reactor Specification

The content of this report is about reactor specification information and is highly customisable. The user chooses up to 20 parameters related to reactor basic information and design characteristics, which will be displayed as columns in the report.

Reactor Specification

Reactor Group

All Reactors

Data Columns

Basic Information : Unit Name, Status, Country, Type, Model

Design Characteristics : Reactor vessel shape, Fuel material, Average discharge burnup [MWd/t], Refuelling type

								No. of reactors
TOTALS:								1024
Unit Name	**Status**	**Country**	**Type**	**Model**	**Reactor vessel shape**	**Fuel material**	**Average discharge burnup [MWd/t]**	**Refuelling type**
AGESTA	Permanent Shutdown	SWEDEN	PHWR			UO2	8500	ON-line
AKADEMIK LOMONOSOV 1	Under Construction	RUSSIA	PWR	KLT-40S 'Floating'	Cylindrical, Hemispherical End	Other	68700	OFF-line
AKADEMIK LOMONOSOV 2	Under Construction	RUSSIA	PWR	KLT-40S 'Floating'	Cylindrical, Hemispherical End	Other	68700	OFF-line
AKKUYU	Suspended Plan	TURKEY	PWR					
ALLENS CREEK-1	Cancelled Plan	UNITED STATES OF AMERICA	BWR		Cylindrical, Hemispherical End			OFF-line
ALLENS CREEK-2	Cancelled Plan	UNITED STATES OF AMERICA	BWR		Cylindrical, Hemispherical End			OFF-line
ALMARAZ-1	Operational	SPAIN	PWR	WE 3-loops	Cylindrical, Hemispherical End	UO2	58000	OFF-line
ALMARAZ-2	Operational	SPAIN	PWR	WE 3-loops	Cylindrical, Hemispherical End	UO2	45000	OFF-line
ANGRA-1	Operational	BRAZIL	PWR	2-loop WE	Cylindrical, Hemispherical End	UO2	33000	OFF-line
ANGRA-2	Operational	BRAZIL	PWR	PRE KONVOI	Cylindrical, Hemispherical End	UO2	35000	OFF-line
ANGRA-3	Under Construction	BRAZIL	PWR	PRE KONVOI	Cylindrical, Hemispherical End	UO2	34000	OFF-line
APS-1 OBNINSK	Permanent Shutdown	RUSSIA	LWGR	AM-1		U		ON-line
ARKANSAS ONE-1	Operational	UNITED STATES OF AMERICA	PWR	B&W (L-loop) DRYAMB	Cylindrical, Hemispherical End	UO2	35000	OFF-line

FIG. 5-2. Example of the Reactor Specification Report.

Concept:

- A selected set of specification information is displayed for a selected reactor group.
- A minimum of one and maximum of 20 items can be selected for basic information and design characteristics.
- The report always contains the latest information available in the PRIS database.
- Up to three summary levels (Region, Country, Site, and Type) can be selected by the user. The summaries only contain the number of reactors for each group.

Condition:

- The report includes all reactors from a selected group and reflects various reactor specifications sorted by the chosen summary.
- The report does not filter by reactor status. It includes reactors that are filtered out by most other PRISTA reports (e.g. cancelled construction, suspended construction, cancelled plan, suspended plan, planned).

Data Selection:

- Basic reactor information is selected from the Reactor table of the PRIS database, the Long-term Shutdown Details table as well as several reference tables (Country, Region, Type, Status, Site, Climatic Zone, Site Location, Operator, and Contractor).
- Design Characteristics information is selected from the Template Char and Reactor Char tables.

5.2. Operational Data

5.2.1. Performance Indicators – Histogram

This report provides an alternative view on reactor performance indicators by visualising the distribution of performance indicator values across a reactors group in percentage intervals. The data is provided as a histogram chart as well as a data table.

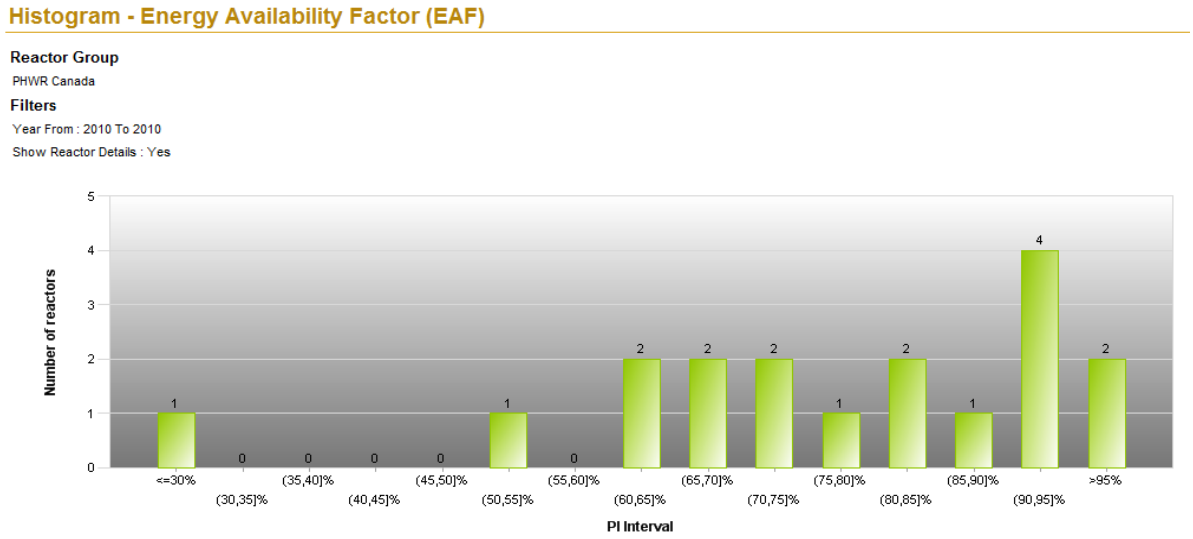


FIG. 5-3. Example of the PI Histogram Report.

Concept:

- The report reflects the number of reactors and sum of RUP at each performance indicator percentage interval.
- The report has two mandatory parameters:
  - The reporting period ("from" year – "to" year). The default selection is the previous year.
  - The performance indicator (EAF, LF, etc.) to be calculated.
- Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, Year and Age) can be applied to the result set.
- The Show Reactor Details option provides reactor level performance indicator values in addition to summary level results. Reactor level details are the name and type of the reactor unit, its RUP as well as the PI value for the year/reporting period.

Condition:

- Histogram intervals are adjustable in the report. Intervals are defined by interval width, initial value and end value. (i.e. 10% intervals from 10% to 90%). The total number of intervals in the report is limited to 20.
- Performance indicators are calculated using the same formulae as in the PI report.
- In contrast to the general Performance Indicator report, however, PI values are calculated from a reactor's grid connection date and include trial operation. Also, the 15 day borderline condition does not apply.
- The report does not check for data completeness. If annual production data for a reactor is available, it is used to calculate the PI value without considering if the data is complete.

– When grouping by age or year, a given reactor can appear in several groups of the result set. The performance indicator values on the reactor level are to be interpreted as value for the year rather than for the whole reporting period. This also changes the meaning of report level totals, as a single reactor is counted several times: one per year of the reporting period.
– Parentheses convention for intervals: (x,y) is intervals for PI > x and PI ≤ y

Data Selection:

– Reactor information is from the Reactor table and several reference tables of the PRIS database (Country, Region, Type, Site, Climatic Zone, and Site Location).
– Unlike for the Performance Indicator reports, PI values are calculated from the Annual Production data table.
– RUP is the latest net electrical capacity from the Reactor table.

5.2.2. Performance Indicators – Lifetime Indicators

This report generates statistics of reactors' lifetime performance indicators up to the end of a given year.

Lifetime Forced Loss Rate (FLR)

Reactor Group
All Reactors
Filters
Lifetime values up to year : 2010
Show Reactor Details : No
Show Operational Reactor : Yes
Summaries
Climatic Zone, Type

	Weighted Average	Median	Best Quartile	Minimum	Standard Deviation	No. of Reactors
TOTALS:	6.48	4.75	2.29	63.03	7.09	440
Mild/Temperate zone	6.43	4.68	2.27	63.03	6.80	416
Sub Arctic zone	3.04	2.56	1.11	3.34	1.01	8
Subtropical zone	14.70	12.02	6.41	47.05	11.47	14
Tropical zone	5.53	5.42	4.51	6.33	1.29	2

FIG. 5-4. Example of the Lifetime PI Report.

Concept:

– The report provides aggregated summaries of a selected lifetime of performance indicators.
– The report provides several statistical values (weighted average, median, best quartile, minimum, standard deviation and number of reactors) for the chosen performance indicator and the selected summary criteria.
– The report has three mandatory parameters:
  - The base year for the report. By default, the previous year is selected. PI values will include all data up to and including the selected year.
  - The lifetime performance indicator (EAF, LF, etc.) to be calculated
  - A filter to indicate whether the report includes reactors that are operational at the end of the reporting year. This filter is selected by default.

– Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, and Age) can be applied to the result set. A reactor will only appear in a single summary group (age is meant to be the reactor's age at the end of the reporting year).
– The Show Reactor Details option provides reactor level performance indicator values in addition to summary level results. Reactor level details include the country, name, type, model and status of the reactor unit as well as its net electrical capacity (RUP) at the end of the reporting year.

Condition:

– Lifetime indicators are based on available monthly production data in PRIS from the start of the commercial operation of a reactor.
– Reactors are only included in the report if monthly production data is available for at least 50% of the months that a reactor is operational (excluding long-term shutdowns).
– RUP is the net electrical capacity of a reactor unit at the end of the reporting year.

Data Selection:

– PI calculations are based on all monthly performance data available in PRIS until the end of selected year. The basic selection criteria (monthly data from commercial date, 50% data completeness condition, 15 day borderline check) are the same as for the regular Performance Indicator report described earlier in this document.
– Reactor specification information is based on the Reactor table of the PRIS database and several reference tables (Status, Country, Region, Type, Site, SiteLocation, and ClimaticZone).
– RUP is reconstructed from monthly production data (in AnnualElectricityReconstruction) and corresponds to the RUP at the end of the reporting year. If the reactor is shutdown, it is the RUP before the permanent shutdown that is used. If the reactor is in long-term shutdown, the last-known RUP before the long-term shutdown is used.

5.3. Outages

The detailed outage records captured in PRIS allow users to analyse energy losses and downtime caused by power reductions and reactor shutdowns. All outage reports in PRISTA are based on the PRIS outage coding system.

For the purpose of PRIS coding, outages are defined as any status of a reactor unit, when its actual output power is lower than the reference unit power for a period of time. By this definition, outages include both power reductions and unit shutdowns. These are referred to as partial and full outages respectively.

5.3.1. Full Outage Statistics – Per Outage

This report provides statistical information about full outages, i.e. outages that have caused a reactor shutdown. Unlike the "Full Outage Statistics – Per Reactor-Year", this report only considers outages that started in the reporting period. For calculating outage duration and energy loss statistics (total, average, max, min, etc.), the duration and energy loss of the whole (combined) outage are taken into account, even if the outage ends after the end of the reporting period. The report is "event-based", as all statistics are calculated "per outage".

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Full Outage Statistics - Per Outage

Reactor Group
All Reactors
Filters
Year From : 2010 To 2010
Show Reactor Details : Yes
Summaries
Outage Cause

	No.of outages	Duration [hours]				
		Sum	Average	Max	Min	Std. dev.
TOTALS:	1068	559484.71	524	10968.00	0.10	905
Outage Cause: A	535	97019.32	181	10968.00	0.10	589
Outage Cause: B	27	24424.30	905	1888.00	327.00	347
Outage Cause: C	260	345581.76	1329	6322.00	120.00	890
Outage Cause: D	87	48085.67	553	4447.00	1.00	735
Outage Cause: E	28	8799.41	314	6295.00	0.10	1207
Outage Cause: F	2	7554.00	3777	7008.00	546.00	4569
Outage Cause: G	1	88.70	89	88.70	88.70	0
Outage Cause: H	7	5806.43	829	5318.00	11.00	1981
Outage Cause: J	28	2855.37	102	378.15	3.15	116
Outage Cause: K	7	3308.65	473	1175.00	7.65	393
Outage Cause: L	35	1648.54	47	190.35	0.10	51

FIG. 5-5. Example of Full Outage Statistics Report.

Concept:

- The report provides an analysis of “full outages”, i.e. outages when a reactor unit was disconnected from the grid.
- Statistics include sum, average per outage, maximum per outage, minimum per outage and standard deviation per outage for both duration [hours] and energy losses [GWh].
- The report can be generated for a historical period up to and including the current year. By default, the previous year is selected as a reporting period.
- Up to three levels of grouping can be applied to the result set. In addition to standard grouping criteria (Region, Country, Type, Current Age, Year), the report support outage related grouping criteria (Outage Type 1st, 2nd and 3rd character; Outage Cause, Outage System).
- The Show Reactor Details option provides reactor level performance outage statistics in addition to summary level results.

Condition:

- This report deals with ‘combined’ outages, where several outage records (fragments) belonging to the same event are logically linked into a single combined outage. For the purposes of the report, combined outages are always counted as one outage, no matter how many fragments they contain.
- This report only considers full outages that started in the reporting period. Combined outages are considered if the start date of the first outage fragment is within the reporting period.
- Duration and energy loss statistics are calculated from the duration and energy loss values of the entire combined outage, even if the outage lasted beyond the end of the reporting period.
- For combined outages, only full outage fragments are considered for the calculation of energy loss and duration. If the same combined outage also has partial outage fragments, their duration and energy loss are disregarded.
- RUP is the RUP of the reactor unit at the end of the reporting period.

– Age in summaries refers to the current age of a reactor, independently of the reporting period chosen.
– For combined outages, outage related summary criteria consider the outage type, system and cause of the combined outage.
– When selecting an outage related criteria or the year for grouping, any given reactor may appear in several summary groups.
– Only full outages that started while a reactor was operational i.e. between a reactor's grid date and shutdown date, excluding long-term shutdowns are considered.

Data Selection:

– Outage information is extracted from the Outage records in the PRIS database. Primarily the OutagesCombined table is used.

5.3.2. Outages – Full Outage Statistics – Per Reactor-Year

This report deals with all full outages that relate to the reporting period. It includes combined outages that may have started prior to the reporting period and may extend beyond the reporting period. However, duration and energy loss are only calculated from those full outage fragments that lie within the reporting period.

Unlike the 'Full Outage Statistics – Per Outage' report, this report is time based and calculates statistical values per Reactor-Year.

Full Outage Statistics - Per Reactor Year

Reactor Group
All Reactors

Filters
Year From : 2008 To 2010
Show Reactor Details : Yes

Summaries
Type, Outage Type - 1st Character

	ISO Code	Unit	Type	RUP [MWe]	No.of outages	Reactor Years	Frequency [per reactor-year]	Duration [hours] Sum	Average	Max	Min
TOTALS:					3232	1312.5	2.46	2180766.68	1661.54	8784	0
BWR					536	278.17	1.93	579660.08	2083.86	8784	0
P-Planned					264	278.17	0.95	471146.71	1693.76	8784	0
U-Unplanned					252	278.17	0.91	100164.7	360.09	8784	0
X-External					20	278.17	0.07	8348.67	30.01	3426	0
FBR					25	5.08	4.92	16572	3260.07	6105	761
P-Planned					14	5.08	2.75	15409	3031.28	6068	761
	FR	PHENIX	FBR	130	8	2.08	3.84	9185	4408.8	6068	761
	RU	BELOYARSKY-3 (BN-600)	FBR	560	6	3	2	6224	2074.67	2219	1981
U-Unplanned					9	5.08	1.77	1036	203.8	999	0
X-External					2	5.08	0.39	127	24.98	127	0
GCR					112	54	2.07	145014.25	2685.45	8784	0
LWGR					105	47	2.23	94456.5	2009.71	8760	70

FIG. 5-6. Example of the Full Outage Statistics per Year Report.

Concept:

- The report provides an analysis of 'full' outages, i.e. outages for a reactor unit that was disconnected from the grid.
- The report includes number of outages, number of reactor-years and frequency of outages per reactor-year.
- Statistics include sum, average per reactor-year, maximum per reactor-year, minimum per reactor-year and standard deviation per reactor-year for both duration [hours] and energy losses [GWh].
- The required criterion is a chosen year or year range. The earliest year to query is 2004, as for the previous years the outage records are not combined by logical links. Using the report for years before 2004 might lead to incorrect calculation of outage frequencies.
- The report can be summarized by the categories of standard reports (country, site, etc.) and by outage codes. While summaries by standard categories, such as "country", are disjunctive, summaries by outage codes are not. In other words, a reactor can have outages of several types in any reporting period and can appear in several subgroups. This has a major impact on how reactor-years are calculated on the summary level.
- The Show Reactor Details option provides reactor level performance outage statistics in addition to summary level results.

Condition:

- The report deals with 'combined' outages where more outage records (fragments) belonging to the same event are combined by logic links into one outage.
- Combined outages are considered if at least one outage fragment starts in the reporting period.
- Fragments linked to combined outages contribute to the outage count "number of outages" as one outage.
- For the calculation of duration and energy loss statistics, only those fragments of a combined outage that start and end within the reporting period are considered. Moreover, only the duration and energy loss of fragments of type "full" are considered.
- A reactor-year is the equivalent of 12 months when the reactor is in commercial operation. As reactor-years are calculated with month precision, it is possible that the number of reactor-years is lower than the number of years in the reporting period because the reactor started commercial operation during the reporting period or because it was shut down or because of a long-term shutdown.
- Aggregated reactor-years are calculated from the number of months each reactor in the report was in commercial operational during the reporting period. Calculation of reactor-years in summaries depends on their exclusivity. A summary is exclusive if each reactor belongs to only one summary group, such as country, reactor type, or site. If a summary is exclusive, the total reactor-years is a sum of those belonging to this group. When a summary is not exclusive, such as in the case of outage codes (a reactor can have multiple outages corresponding to various codes), the total reactor-years will equal that of the broader exclusive group. In other words, the total reactor-years will be the sum of all reactors from the broader (superior) summary.
- Reactors and summaries without any occurrence of selected outages are not displayed but are included in a reactor-year calculation and contribute by a zero value to statistics for duration and energy loss.
- When generating the report for several years and grouping by year, the results on the year group level will be equivalent to generating the report separately for each year. All

numbers and subgroups below the year group only refer to the respective year. All numbers above the year group level refer to the whole reporting period.

– Outage frequency is the number of outages (for a reactor, for a given summary group or for all reactors in the report) per reactor-year.

Data Selection:

– Outage information is extracted from the outage records table in the PRIS database.

5.3.3. Outages – Combined Outage Statistics

An outage can be entered into PRIS in more than one outage record. Outage records that belong to the same outage are called outage fragments. Outage fragments of the same outage are combined by links into one logical record. Among the reasons for outage fragmenting is: monthly reporting, different phases of an outage (shutting down, full outage, ramp-up), unplanned extension of planned outages, etc. Using combined statistics is critical for the calculation of meaningful statistics like outage frequency.

This report provides statistics on combined outage statistics. In contrast to the full outage statistics this report includes also partial outage records (de-rates). Statistics are calculated per reactor-year.

Combined Outage Statistics

Reactor Group
All Reactors

Filters
Year From : 2008 To 2010
All outages related to the reporting period : Yes
Show Reactor Details : Yes

Summaries
Climatic Zone, Outage Cause

	ISO Code	Unit	Type	Reactor Years	No. of outages	Frequency [per reactor-year]	Duration [Hours]	Energy Loss [GWh]
				No. of Reactors	Reactor Years	No. of Outages	Frequency [per reactor-year]	Duration [Hours]	Energy Loss [GWh]
TOTALS:				445	1312.49	14108	11.82	6309350.86	2005937.94
Mild/Temperate zone				**421**	**1240.49**	13331	10.75	5760805.51	1937554.91
Sub Arctic zone				**8**	**24.00**	212	8.83	224984.70	14856.35
Outage Cause: A				**8**	**24.00**	14	0.58	586.10	76.77
	RU	BILIBINO-2	LWGR	3.00	4	1.33	219.10	1.24	
	RU	BILIBINO-3	LWGR	3.00	1	0.33	11.00	0.06	
	RU	BILIBINO-4	LWGR	3.00	1	0.33	44.00	0.12	
	RU	KOLA-2	PWR	3.00	1	0.33	210.00	43.36	
	RU	KOLA-3	PWR	3.00	6	2.00	86.00	30.43	
	RU	KOLA-4	PWR	3.00	1	0.33	16.00	1.56	
Outage Cause: C				**8**	**24.00**	24	1.00	38896.30	6185.78
Outage Cause: D				**8**	**24.00**	12	0.50	4603.00	926.48
Outage Cause: E				**8**	**24.00**	6	0.25	6347.00	66.34
Outage Cause: J				**8**	**24.00**	138	5.75	169303.30	7490.67

FIG. 5-7. Example of the Operating Period Report.

Concept:

- The report provides an analysis of combined outages in PRIS. Compared to Full Outage Statistics this report also deals with partial outage (derates).
- The report may be generated for historical periods up to and including the current year. By default, the previous year is selected as a reporting period.
- For the time being, the earliest year is 2004 for the reporting period. This is because outage records are not combined by logical links prior to 2004, and could lead to misleading statistics calculations.
- Aggregated summaries contain the number of operational reactors, number of reactor-years, number of outages, outage frequency, sum of outage duration [hours] and energy loss [GWh].
- The reports can be summarized by categories of standard reports and by outage codes. Summary by outage codes is not disjunctive for reactors as standard ones (one reactor can have any number of outage codes) therefore calculation of reactor-years differs from standard summaries – see Conditions.
- Outage codes can be chosen as filters:
    - 1st code for the outage type: P - Planned, U - Unplanned, and X - External losses
    - 2nd code to outage character: F - Full or P - Partial outage
    - 3rd code for unplanned outage details: 1 - deferred shutdown, 2 - immediate shutdown, 3 - outage extension, 4 - automatic scram, 5 - manual scram
    - Cause code for a direct cause of an outage:

        - A - Plant Equipment problem/failure
        - B - Refuelling without a maintenance
        - C - Inspection, maintenance, or repair combined with refuelling
        - D - Inspection, maintenance, or repair without refuelling
        - E - Testing of plant systems or components
        - F - Major back-fitting, refurbishment, or upgrading activities with refuelling
        - G - Major back-fitting, refurbishment, or upgrading activities without refuelling
        - H - Nuclear Regulatory Requirements
        - J - Grid limitation, failure or grid unavailability
        - K - Load Following (frequency control, reserve shutdown due to reduced energy demands)
        - L - Human Factor Related
        - M - Governmental requirements or court decisions
        - N - Environmental Conditions (lack of cooling water due to dry conditions, cooling water temperature limits
        - P - Fire
        - R - External restrictions on supply and services (lack of funds due to delayed payments from customers)
        - S - Fuel management limitation (including high flux tilt, stretch out or coast down operation)
        - T - Heat supply (on-site to support next unit or desalination and off-site distribution)
        - U - Security and access control and other preventative shutdown due to external threads
        - Z - Other

- System/Component code (there is a comprehensive list of components to choose from – see Ref. [2])

– The report supports two outage selection modes:

  - Outages related to the reporting period: includes combined outages that may have started before the reporting period but continued into the reporting period.
  - Outages starting in the reporting period.

– The 'Show outage details' checkbox allows the user to display individual outage records. If this checkbox is unchecked, only summary level information and report level totals are displayed.

Condition:

- For "All outages related to the reporting period" the report considers all combined (and non-combined) outages for at least one fragment start in the reporting period. Duration and energy loss is calculated from only those fragments that are within the reporting period. Fragments linked into a combined outage contribute to the outage number as one outage.
- For "Only outages starting in the reporting period" only outages that start in the reporting period are considered. Combined outages are only considered if the start date of the first fragment is in the reporting period. Duration and energy loss is calculated from the values for the entire combined outage, even if the outage lasted beyond the reporting period.
- The aggregated number of reactors is the total number of reactors that were operated (at least partially) in the reporting period.
- A reactor-year is the equivalent of 12 months when the reactor is in commercial operation'. Reactor-years are calculated from the number of months each reactor in the report was operational during the reporting period. The aggregated number of reactor-years is the sum of years during which these reactors where operational in the reporting period. The number of reactor-years might be different from [total number of reactors] * [number of years in the reporting period] as certain reactors included in the report may not have been operational during all years included in the reporting period.
- Calculation of reactor-years in summaries depends on their exclusivity. A summary is exclusive if each reactor belongs to only one summary group, such as country, reactor type, or site. If a summary is exclusive, the total reactor-years is a sum of those belonging to this group. When a summary is not exclusive, such as in the case of outage codes (a reactor can have multiple outages corresponding to various codes), the total reactor-years will equal that of the broader exclusive group. In other words, the total reactor-years will be the sum of all reactors from the broader (superior) summary.
- Reactors and summaries without any occurrence of the selected outages are not displayed but are included in a reactor-year calculation.
- When generating the report for several years and grouping by year, the results on the year group level will be equivalent to generating the report separately for each year. All numbers and subgroups below the year group only refer to the respective year. All numbers above the year group level refer to the whole reporting period.
- Outage frequency is the number of outages (for a reactor, for a given summary group or for all reactors in the report) divided by number of reactor-years.

Data Selection:

- Outage information is extracted from the combined outage records table in the PRIS database.

5.3.4. Outages – Operating Period between Full Outages

This report provides statistics on the duration of continuous operation of power reactors between two full outages (disconnections from the grid).

Operating Period Between Full Outages

Reactor Group
All Reactors

Filters
Year From : 2007 To 2010
Show Reactor Details : Yes

Summaries
Country, Type

	ISO Code	Unit	Total Duration [days]	Mean [days]	Median [days]	Max [days]	Std. dev. [days]
TOTALS:			505668.39	116.14	61.06	731.00	136.54
ARGENTINA			2561.88	71.16	40.48	291.95	82.37
ARMENIA			1242.54	112.96	133.30	291.20	109.78
BELGIUM			9551.51	106.13	68.21	492.94	117.14
BRAZIL			2478.76	65.23	46.25	245.07	67.95
BULGARIA			2418.29	201.52	268.79	342.04	124.54
CANADA			20486.53	97.09	54.90	687.24	115.41
CHINA			14574.12	191.76	163.34	528.62	159.14
CZECH REPUBLIC			7407.43	94.97	40.80	348.16	114.44
FINLAND			5738.06	185.10	186.28	366.23	154.11
BWR			3004.44	136.57	96.69	366.23	145.54
PWR			2733.62	303.74	337.21	363.11	105.56
	FI	LOVIISA-1	1356.06	271.21	328.45	359.03	138.52
	FI	LOVIISA-2	1377.56	344.39	340.18	363.11	12.85
FRANCE			67546.23	58.94	31.02	434.27	72.73
GERMANY			19379.72	151.40	137.69	520.42	133.88
HUNGARY			5000.69	178.60	169.79	344.43	103.32

FIG. 5-8. Example of the Combined Outage Report.

Concept:

- The only mandatory parameter for the report is the reporting period (“from” and “to” year). By default, the previous year is selected as the reporting period.
- Up to three levels of grouping (Region, Country, Type, Current Age and Year) can be applied to the result set. Aggregated summaries contain the total duration of operation between breaks, mean, median, maximum and standard deviation of duration [days] of continuous operation. When grouping by year, each reactor may appear in several groups of the result set.
- No filters are available as the report search duration between any consequent full outages regardless type/cause/system codes.

- The Show Reactor Details option returns operating period data for individual reactors in addition to summary level results. Total, median, mean and maximum operating periods as well as the standard deviations are displayed.

Condition:

- As a general rule, the operating period between two full outages is calculated as the time difference in days between the start date of a full outage "n" and the end date of the previous full outage "n – 1".
- The end date of the previous full outage is calculated as the start date of that outage plus its duration.
- In the case of combined outages containing full outage fragments as well as partial outage fragments, the "full" outage start date is calculated as the start date of the first full outage fragment in the combined outage. The "full" outage end date is calculated as the end date of the last full outage fragment in the combined outage, plus its duration. Hence, the operating period between two combined full outages may be longer than the simple time difference between the start and end dates of these outages.
- If a reactor is in long-term shutdown between two full outages, the restart date is used for calculating the operating period instead of the end date of the previous outage.
- For the first full outage during a reactor's operational life, the operating period is calculated as the time difference between the full outage start date and the grid date of the reactor.
- If the calculated operating period between two full outages is longer than 365 days, additional data consistency checks are applied. To avoid misleading statistics because of missing data, the operating period is only counted if:
    - Annual production data has been reported for the year concerned;
    - Outage data has been reported for the year concerned or the time difference between online hours and total hours is less than two hours.
- Operating periods of less than 24 hours are excluded from the report.

Data Selection:

- Outage information is extracted from the outage records table in the PRIS database. As calculating the operating period preceding each full outage is time-consuming, the data is prepared in a reporting table (Combined Outage Info) on a nightly basis.

5.3.5. Outages – Outage Details

This report provides detailed information about all outages that occurred in the reporting period allowing the user to filter by reactor group as well as by outage-related criteria; the report provides a powerful analysis tool on PRIS outage data.

Outage Details

Reactor Group

Europe

Filters

Year From : 2011 To 2011

View Fragments : Yes

Show Reactor Details : Yes

Summaries

Outage Type - 1st Character

Criteria

Cause : J-Grid limitation, failure or grid unavailability, K-Load-following (frequency control, reserve shutdown due to reduced energy demand)

Type 2nd Character : F

All outages related to the reporting period : Yes

							Number of outages	Duration [Hours]	Energy Loss [MWh]
						TOTALS:	2	105.00	59620.00
X-External							*2*	*105.00*	*59620.00*
	Start Date	Type	Cause	System	Component	Operational mode	Description	Duration[Hours]	Energy Loss [MWh]
	2011-02-25	XP2	J	42	07	Power operation	Decline to cold shutdown reactor at the request of the Swedish National Grid (SVK) for the repair of measuring transformers (400kV).	10.00	5628.00
	2011-02-25	XF	J	42	07	Power operation	Decline to cold shutdown reactor at the request of the Swedish National Grid (SVK) for the repair of measuring transformers (400kV).	40.00	34160.00

FIG. 5-9. Example of the Outage Details Report.

Concept:

- The report provides access to raw outage data stored in PRIS. It is based on combined outages as well as non-combined outages.
- As outage data is considered sensitive, the data is hidden and presented to the user by stripping off country and reactor information. Moreover, the report can be only be generated for all reactors or for a reactor group containing at least three reactors from two different countries.
- The report can be generated for historical periods up to and including the current year. By default, the previous year is selected as a reporting period.
- Individual outage records contain the complete outage code, description, duration [hours] and energy loss [MWh].
- Aggregated summaries contain the number of outages for each group, their total duration and their total energy loss.
- The report can only be summarized by outage related criteria (outage type 1st, 2nd and 3rd character; outage cause and outage system).
- The report supports the following optional filters:
  - Outage Type 1st character: planned (P), unplanned (U) and external (X) outages
  - Outage Type 2nd character: full (F) and partial (P) outages
  - Outage Type 3rd character: deferred shutdown (1), immediate shutdown (2), outage extension (3), manual scram (4) and automatic scram (5)
  - Outage Cause: one, several or all outage causes
  - Outage System/Component: one, several or all outage components
- The 'View Fragments' checkbox allows the user to display the complete structure of combined outages i.e. all fragments
- The report supports two outage selection mode:
  - Outage related to the reporting period: includes combined outages that may have started before the reporting period but continued into the reporting period.

    - Outage starting in the reporting period.
- The ‘Show outage details’ checkbox allows the user to display individual outage records. If this checkbox is unchecked, only summary level information and report level totals are displayed.

Condition:

- The report cannot be generated for reactor groups containing less than three reactors or reactors from less than two different countries
- Outage descriptions are truncated after 200 characters.
- Outage filters are applied at the (combined) outage level. If a user elects to filter by outage type, cause or system/component, the filter is applied to the respective attribute of the combined outage, not of each of the fragments. For example, a report filtered to only include full outages, might include partial outage fragments, provided that these fragments belong to a combined outage of type “full”.
- Similarly, duration and energy loss of combined outages take into account the duration and energy loss of all fragments, not only of those meeting the (combined) outage filter criteria.

Data Selection:

- Outage information is extracted from the outage records table in the PRIS database, primarily from the Outages Combined table. If the “view fragments” option is selected, the Outages table is also queried.

5.4. Non-Electrical Application (NEA) Data:

The electricity production data in PRIS are complemented by information on energy provided by nuclear power plants to non-electrical applications, such as district heating, process heat supply or desalination.

The following reports generate information related to non-electrical applications (NEA).

5.4.1. Specification – Reactors with NEA

This report provides an overview of reactors with non-electrical applications in a selected status of their life cycle – from construction through operation to permanent shutdown.

Overview of reactors with Non Electrical Applications

Operational reactors

Reactor Group
All Reactors

Filters
Base Year : 2011
Show Reactor Details : Yes

Summaries
Country, NEA Application Type

	Number of Reactors with NEA	RUP [MWe]
TOTALS:	75	52387
BULGARIA	2	1906
CZECH REPUBLIC	2	1926
HUNGARY	3	1419
INDIA	6	1091
JAPAN	9	8076
PAKISTAN	1	125
ROMANIA	2	1300
RUSSIA	30	20793
District Heating	29	19843
Process Heating	26	20749
SLOVAKIA	2	944
SWITZERLAND	3	1700
UKRAINE	15	13107

FIG. 5-10. Example of the Non-Electrical Application Report.

Concept:

- The report has the same concept as the Year-end Status report. However, it only includes reactors that have non-electrical applications.
- The report has two mandatory parameters: the base year for which the report shall be generated and one or more reactor status to be considered.
- The report can be generated for the current year and for historical years. By default, the current year is chosen as a base year.
- The user must select at least one reactor status to be included in the report. By default, the status "operational" is selected.
- For reactors under construction, there are two options.
    - "Under construction (current & completed projects)" includes all reactors that were under construction in the base year, excluding projects that were eventually suspended or cancelled.
    - "Under construction (incl. Cancelled/Suspended) includes all projects that were under construction in the base year, no matter whether they were completed or not.
- Optionally, an age filter can be applied (to reactors in operation, in long-term shutdown or in permanent shutdown), so that only reactors that were of a certain age in the base year are considered.
- Up to three levels of grouping (NEA Application Type, Region, Climatic Zone, Country, Location, Site, Type, and Age) can be applied to the result set. A reactor can only appear in exactly one group in the result set.
- The Show Reactor Details option returns specification data about individual reactors in addition to summary level results. Detailed information about each reactor includes basic design information (e.g. type, model, RUP, etc.) as well as information about the NEA types supported by a particular reactor (process heating, district heating and/or desalination).

Condition:

- For historical years, the report reflects reactor status and Reference Unit Power (RUP) at the end of the base year. In the case of the current year, the latest situation is reflected.
- Reactors that were in a given status during the year but have changed status before the end of that year are not included in the report.
- For reactors under construction the design net capacity is used as RUP.
- For a reactor in long-term shutdown the RUP is the net capacity when it was shutdown.
- For a reactor in a status of permanent shutdown the RUP is its latest net capacity (when it was shutdown).

Data Selection:

- Reactor detail information is from Reactor table of the PRIS database.
- For reactors that have reached the "operational" stage, RUP is reconstructed from monthly production data to reflect RUP revisions. The closest available match from the Annual Electricity Reconstruction table is used for that purpose. For planned reactors and reactors under construction (including cancelled and suspended projects), design net electrical capacity from the Reactor table is used.
- When age is used as a filter or summary criterion, it means the age of a reactor at the end of selected year.
- As PRIS does not store historical status information about reactors, the status of a reactor in a given year is reconstructed from its current status as well as milestone dates available in the Reactor table.
- NEA Information whether a given reactor produces energy for a specific NEA application type is selected for the NEA unit table.

5.4.2. Production – Energy Utilized for NEA

This report provides detailed information about nuclear energy used for non-electrical applications. For the reporting year selected, it provides the amount of energy utilized for process heating, district heating and desalination as well as the electrical equivalent of heat.

Energy produced from Non Electrical Applications

Reactor Group

All Reactors

Filters

Base Year : 2010

Show Reactor Details : Yes

NEA Application type : Process Heating ,District Heating ,Desalination

Summaries

NEA Application Type

	Number of Reactors with NEA	RUP [MWe]	Total Heat [GCal]	Electrical equivalent of heat [GWh]	% of NEA
TOTALS:	75	52387	7247140.04	2491.77	0.01
Desalination	12	8611	151174.01	77.15	0.00

ISO Code	Unit	Type	Model	District Heating	Process Heating	Desalination			Total Heat		% of NEA
				PDH Thermal energy [GCal]	PPH Thermal energy [GCal]	PDI Thermal energy [GCal]	Electrical energy for Reverse Osmosis [GWh]	Water production [m3]	Total Heat (PDH + PPH + PDI)	Electrical equivalent of heat [GWh]	
IN	MADRAS-1	PHWR	Horizontal Pres			9950.70	0.00	0.00	9950.70	3.46	0.19
IN	MADRAS-2	PHWR	Horizontal Pres			0.00	0.00	0.00	0.00	0.00	0
JP	GENKAI-3	PWR	M (4-loop)			26170.00	0.00	367835.00	26170.00	9.11	0.09
JP	GENKAI-4	PWR	M (4-loop)			1906.00	0.00	25742.00	1906.00	0.66	0.01
JP	IKATA-1	PWR	M (2-loop)			0.00	0.00	333362.00	8667.41	8.67	0.18
JP	IKATA-2	PWR	M (2-loop)							0.00	0
JP	IKATA-3	PWR	M (3-loop)			0.00	0.00	267300.00	6949.80	6.95	0.09
JP	OHI-1	PWR	W (4-loop)			0.00	0.00	1072387.00	27882.06	27.88	0.28
JP	OHI-2	PWR	W (4-loop)							0.00	0
JP	TAKAHAMA-3	PWR	M (3-loop)			0.00	0.00	480340.00	12488.84	12.49	0.17
JP	TAKAHAMA-4	PWR	M (3-loop)							0.00	0

FIG. 5-11. Example of the NEA Energy Report.

Concept:

- The report is a summary of the three non-electrical application types: process heating, district heating and desalination.
- For report totals and summaries, it returns the number and net electrical capacity of reactors with NEA, total heat production [GCal], the electrical equivalent of heat [GWh], and the percentage of energy used for NEA.
- The report has two mandatory parameters:
  - The base year for which the report shall be generated. By default, the previous year is selected.
  - The non-electrical application types to be included: process heating, district heating and/or desalination. By default, all three application types are included.
- Up to three levels of grouping (NEA Application Type, Region, Climatic Zone, Country, Location, Site, Type, and Age) can be applied to the result set. A reactor can only appear in exactly one group in the result set.
- The Show Reactor Details option returns specification data about individual reactors in addition to summary level results. Detailed information about each reactor includes basic design information (e.g. type, model, RUP, etc.) as well as detailed information about NEA energy generation.

Condition:

- The report reflects the Reference Unit Power (RUP) at the end of a selected year. In the case of current year, it reflects the latest situation.
- Total heat is reported also as ‘Electrical Equivalent of Heat’ (EEH) using either entered data or calculation by a formula implemented in PRIS.
- The report only includes reactors that were operational in the reporting year.
- When age is used as a summary criterion, it means the age of a reactor at the end of the selected year.

– Percentage of NEA is calculated from the ratio of EEH to REG (reference electricity generation).

Data Selection:

– Reactor detail information is from reactor and site tables of the PRIS database.
– NEA information is from the NEA tables in PRIS (WAnnualProductionHeat, WAnnualProductionWater).
– EEH is selected from the AnnualProduction table.
– RUP is reconstructed from monthly production data to reflect RUP revisions. The closest available match from the AnnualElectricityReconstruction table is used for that purpose.

5.4.3. Production – Load Factor Including Heat (LFH)

This performance indicator report provides statistics for a modified Load Factor (LF). LFH takes into account the energy used for non-electrical applications besides electricity production for a reporting period spanning one or several consecutive calendar years.

Load Factor Including Heat (LFH)

Reactor Group
All Reactors

Filters
Year From : 2010 To 2010
Show Reactor Details : Yes

Summaries
Location, Type

*Note 1: Data completeness is the percentage of months for which data is available to the total number of months in the reporting period. Only months during which a reactor was operational are considered. The column is displayed if data completeness is less than 100% or if the number of qualified reactors does not match the number of operated reactors.

*Note 2: Values displayed in red do not meet the 50% criterion and the reactors concerned are disqualified from the calculation of aggregate statistics (including data completeness).

	Weighted Average	Median	Best Quartile	Minimum	Standard Deviation	No. of Operated Reactors
TOTALS:	80.62	84.88	92.09	0.00	21.34	441
Inland near a lake location	86.26	88.54	94.03	52.67	12.09	72
BWR	92.10	93.16	97.66	79.92	7.10	8

ISO Code	Unit	Type	Model	RUP [MWe]	LF-NEA[%]*
US	CLINTON-1	BWR	BWR-6 (Mark 3)	1065	92.31
US	ENRICO FERMI -2	BWR	BWR-4 (Mark 1)	1106	79.92
US	FITZPATRICK	BWR	BWR-4 (Mark 1)	855	84.94
US	LASALLE-1	BWR	BWR-5 (Mark 2)	1118	94.01
US	LASALLE-2	BWR	BWR-5 (Mark 2)	1120	101.17
US	NINE MILE POINT-1	BWR	BWR-2 (Mark 1)	621	97.32
US	NINE MILE POINT-2	BWR	BWR-5 (Mark 2)	1143	89.34
US	PERRY-1	BWR	BWR-6 (Mark 3)	1240	97.77

FBR	76.62	76.62	76.62	76.62	1
LWGR	83.34	84.27	94.30	69.98	12.30	4
PHWR	82.43	81.06	93.80	52.67	13.65	17
PWR	86.58	88.94	94.56	56.74	11.80	42
Inland near a river location	82.48	85.20	92.05	0.00	21.64	181
Seacoast location	76.32	84.05	91.37	0.00	23.27	188

FIG. 5-12. Example of the LHL Report.

Concept:

– The report provides the LFH as weighted average, median, best quartile, minimum value and standard deviation for a chosen reactor group.
– The report includes all commercially operated reactors – whether they have non-electrical applications or not. For reactors without NEA, LFH is equivalent to LF.

- The only mandatory parameter for the report is the reporting period ("from" and "to" year). The report may be generated for historical periods up to and including the previous year. By default, the previous year is selected as a reporting period.
- Up to three levels of grouping (Region, Climatic Zone, Country, Location, Site, Type, Age, and Year) can be applied to the result set. If age and/or year are selected, any given reactor may be listed in several summary groups.
- The Show Reactor Details option provides the reactor-level LFH values in addition to summary-level results. Detailed information about each reactor also includes basic specification information, i.e. name, type, model and RUP in the relevant reporting year.

Condition:

- LFH is defined as the ratio of EG+EEH to REG, expressed as a percentage, where EG is for electricity generated, EEH for electrical equivalent of heat and REG for reference energy generation
- Electricity generation (EG) and reference energy generation (REG) are calculated from monthly production data. The electrical equivalent of heat (EEH) is calculated from annual production data. LFH is thus a combination of both: monthly and annual production records.
- The report reflects the performance indicator value and Reference Unit Power (RUP) at the end of a selected year or year range. In the case of the current year it reflects the latest situation.
- Reactors that were not operational for at least one month during the reporting period because they were in long-term shutdown are automatically excluded from the report.
- Reference Unit Power (RUP) refers to the net electrical capacity at the end of the final year of the reporting period (unless grouping by year is selected). In the current year, RUP reflects the latest situation.
- Age in summaries refers to a reactor's age at the end of the reporting period. Exception: when age and year are selected as summary criteria in combination, age is calculated separately for each year in the reporting period.
- For periods/years for which data collection is not completed or data is missing, an additional data completeness indicator in per cent is displayed. It is calculated as a ratio of number of years that NEG data is available to the number of years that a reactor was operational. The data completeness indicator helps the user interpret the reliability/accuracy of the performance indicator values.
- On the summary and report total levels, only reactors where the data completeness is > 50% are considered ("qualified reactors"). The qualified reactors column indicates how many reactors out of the operational reactors were considered for summary/totals calculation.

Data Selection:

- Monthly production data is filtered to only include the months that a reactor is operational, i.e. the period from the reactor's commercial date to its permanent shutdown date, excluding periods of long-term shutdown. Please refer to the performance indicator report for all conditions that apply.
- The 15 day condition is applied to decide whether "borderline" months, i.e. the months of the commercial date, the long-term shutdown date, the restart date and the permanent shutdown date, should be included in the calculation.
- Reactor detail information is selected from the Reactor table.

- RUP is taken from the monthly production tables. For historical years without production data RUP is reconstructed by closest available production data or by information in the Reactor table.

6. MAP BASED REPORTS

The mapping feature enables the user to select and obtain information regarding specific sites and reactors. Pins display the location of all sites from around the world on a map via Google.

1) Using a dropdown menu, as shown in Fig. 6-1, the user can first filter on the status of reactors to be displayed on the map. The map can then be set to display reactors that are classified operational, under construction, planned, long-term shutdown, permanent shutdown, suspended construction, or cancelled construction. Although the default setting displays only operational reactors, the user may also view all statuses at once.

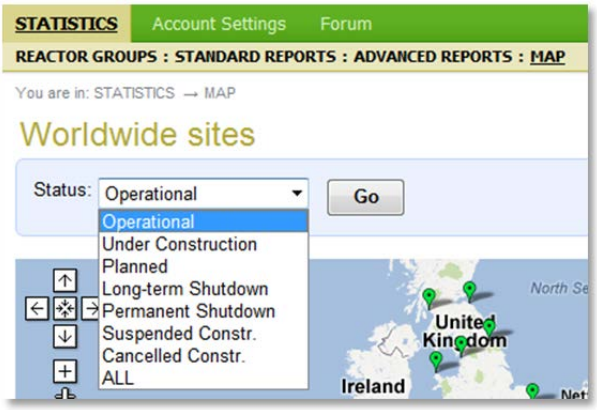

FIG. 6-1. Status selection.

2) Selecting a site on the map will display site-specific information (Fig. 6-2) including a picture and the type, capacity, and current status of units within that site.

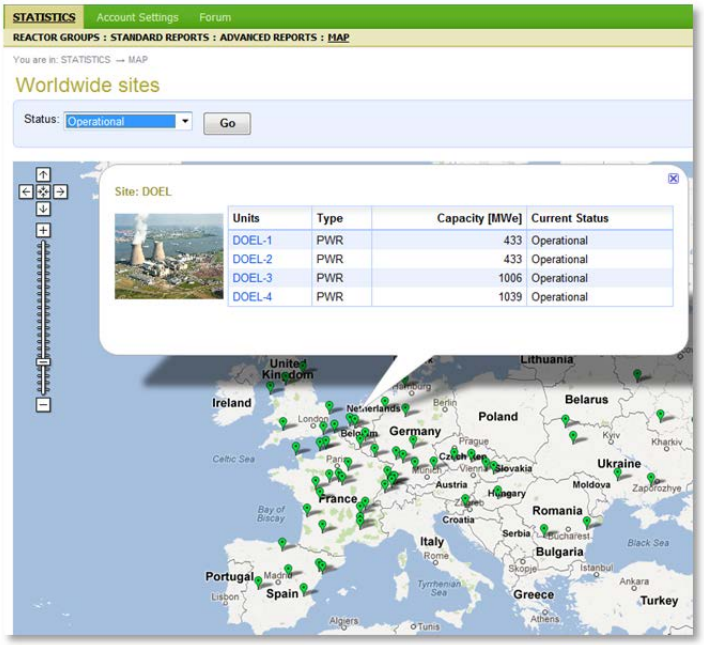

FIG. 6-2. Site selection.

3) Finally, selecting a specific reactor will display reactor-specific information as seen in Fig. 6-3. The criteria highlighted in blue, such as the site, operator, owner, reactor supplier, and turbine supplier can be expand by selecting the adjacent symbols for more detailed information.

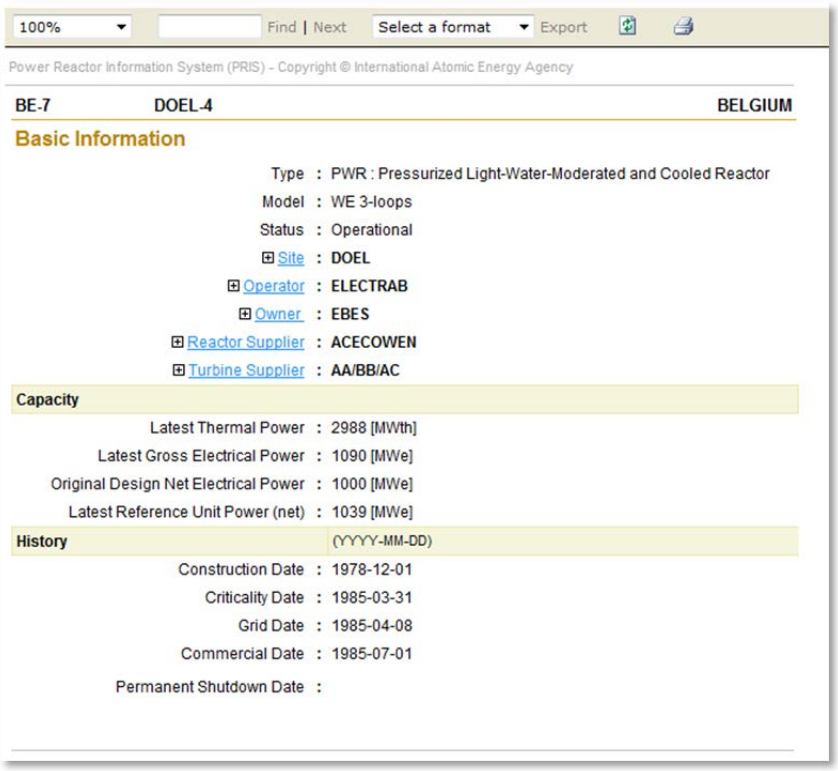

FIG. 6-3. Reactor selection.

REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, The Power Reactor Information System (PRIS) and its Extension to Non-electrical Applications, Decommissioning and Delayed Projects Information, IAEA Technical Reports Series No. 428, IAEA, Vienna (2005).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, International Outage Coding System for Nuclear Power Plants, IAEA-TECDOC-1393, IAEA, Vienna (2004).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Power Plant Design Characteristics, IAEA-TECDOC-1544, IAEA, Vienna (2007).

GLOSSARY

available capacity:

Maximum net capacity at a given moment at which the reactor unit is able or is authorized to be operated at a continuous rating under the prevailing conditions assuming unlimited transmission facilities. It is a capacity available for the grid.

commercial operation:

In PRIS a commercial operation of a reactor is from its Commercial Operation Date. A period from the first grid connection to the Commercial Date is called 'trial operation'. Performance Indicators in PRIS reports are calculated for commercial operation. Electricity production is calculated from the first grid connection.

commercial operation start:

The date, when the plant is handed over by the contractors to the owner and declared officially in commercial operation.

construction start date:

The date, when first major placing of concrete, usually for the base mat of the reactor building, is done. From this date the reactor is considered to be under construction.

electricity supplied:

Net electrical energy produced during the reference period as measured at the unit outlet terminals, i.e. after deducting the electrical energy taken by unit auxiliaries and the losses in transformers that are considered integral parts of the unit. Also called as Net Energy Generated. Measured in MW·h.

energy loss (EL):

Energy which could have been produced during the reference period by the unavailable capacity. It is categorized into three types: PEL - planned energy loss; UEL - unplanned energy loss; XEL - energy loss due to causes external to the plant. Energy loss related to the outage records is the total energy that was not supplied to the grid due to the outage.

full outage:

An outage is considered full when the reactor unit is disconnected from the grid.

grid connection date:

The date, when the plant is first connected to the electrical grid for the supply of power. After this date, the plant is considered in operation.

gross capacity:

Reference gross electrical power of the plant expressed in MW(e). The maximum (electrical) power that could be maintained continuously throughout a prolonged period of operation under reference ambient conditions. The gross electrical power is measured at the output terminals of the turbine generator.

Long-term shutdown (LTS):

Reactor is considered in long-term shutdown status, if it has been shut down for an extended period (usually several years) without any firm recovery schedule at the beginning but there is the intention of re-starting the unit eventually.

non-electrical application (NEA):

Some power reactor units produce a portion of their output energy in the form of heat/steam for non-electrical applications (desalination, district heating and industrial heat). This energy is also reported into PRIS.

nuclear power plant (NPP):

A nuclear power plant is a thermal power station in which the heat source is one or more nuclear reactors. As in a conventional thermal power station, the heat is used to generate steam which drives a steam turbine connected to a generator which produces electricity.

nuclear share:

Percentage share by country of electricity generation mix for nuclear power. The ratio of the nuclear electricity production, to the total electricity production from all sources in a country.

nuclear steam supply system (NSSS):

The NSSS consists of a nuclear reactor and all of the components necessary to produce high pressure steam, which is used to turn the turbine for the electrical generator.

on-line hours:

Total clock hours in the reporting period during which the unit was operated with at least one main generator connected to the grid.

operational reactor:

In PRIS a reactor is considered as 'operational' or 'in operation' from its first grid connection to permanent shutdown. During the status 'long-term shutdown' a reactor is excluded from operational reactors.

outage:

For the purpose of PRIS coding, the 'outage' is defined as any status of a reactor unit, when its actual output power is lower than the reference unit power for a period of time. By this definition, the outage includes both power reduction and unit shutdown.

outage cause:

In PRIS only direct outage causes are coded. The direct cause is defined as an immediate action or condition that has directly resulted in the outage.

outage coding system:

The set of internationally accepted codes used for outage records in PRIS[1].

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, International Outage Coding System for Nuclear Power Plants, IAEA-TECDOC-1393, IAEA, Vienna (2004).

outage duration:

The total clock hours of the outage measured from the beginning of the reference period or the outage, whichever comes last, to the end of the reference period or the outage, whichever comes first.

outage extension:

The outage extension is defined as an unplanned portion of a planned outage, causing prolongation of the planned outage.

partial outage:

An outage is considered partial if the actual unit output power is lower than its reference value but the reactor unit is still connected to the grid.

permanent shutdown date:

The date when the plant is officially declared by the owner to be taken out of commercial operation and shut down permanently.

planned outage:

An outage is considered planned, if it was scheduled at least four weeks in advance.

power reactor:

A nuclear reactor is a device to initiate and control a sustained nuclear chain reaction. In a power reactor, the energy released is used as heat to make steam to generate electricity.

PRIS-statistics (PRISTA):

A web-based reporting application used by registered users to produce reports and statistics from PRIS.

reactor age:

Number of years the reactor was in operation from its first grid connection to a referred date.

reactor model:

The reactor model identifies a specific reactor design series (e.g. Magnox, AGR... or VVER V-213, Konvoi, EPR, BWR-6,...) within a particular reactor type (GCR or PWR respectively). All models of the same reactor type usually have the same basic design characteristics (moderator and coolant type and form).

reactor status:

One of power reactor stages during its lifecycle: Planned; Under construction; In operational; In long-term shutdown; Permanently shut down

reactor type:

Classification of power reactors by coolant and moderator material.

reactor-year:

A reactor-year is the equivalent of 12 months when the reactor is in commercial operation.

reference energy generation (REG):

Reference energy generation (MWh or GWh) for the period is the net electricity output that would be produced if a reactor unit is operated at its rated power output for the entire period.

reference unit power (RUP):

The reference unit power expressed in units of megawatt (electrical) is the maximum (electrical) power that could be maintained continuously throughout a prolonged period of operation under reference ambient conditions. The power value is measured at the unit outlet terminals, i.e. after deducting the power taken by unit auxiliaries and the losses in the transformers that are considered integral parts of the unit. The reference unit power is expected to remain constant unless following design changes, or a new permanent authorization, the management decides to amend the original value.

scram:

The reactor scram is defined as a reactor emergency shutdown achieved by rapid insertion of negative reactivity into the reactor core, which can be done either manually or automatically.

thermal capacity:

The Reference thermal power of the plant expressed in MW(th). The reactor thermal power is the net heat transferred from the fuel to the coolant.

trial operation:

In PRIS a reactor is in trial operation from its first grid connection to the date when it is officially declared in commercial operation (Commercial Operation Date).

unavailability:

A status when the plant is not able to operate at its reference power. This condition, which may be under or beyond plant management control, should only reflect lack of availability of the plant itself, regardless of energy demand, transmission grid condition or political situation in the country.

web-enabled data acquisition system (WEDAS):

Web based application used by PRIS data providers for on-line data entry to the PRIS database.

ABBREVIATIONS

AGR	advanced gas-cooled reactor
BWR	boiling water reactor
CF	capacity factor
DI	data insufficient
EAF	energy availability factor
EEH	The electrical equivalent of heat
EG	electricity generated
EUF	energy unavailability factor
FBR	Fastbreeder reactor
FLR	Forced loss rate
Gcal	Gigacalorie
GCR	Gas cooled reactor
GW	Gigawatt
GW·h	Gigawatt-hour
HTGR	high temperature gas cooled graphite moderated reactor
HWGCR	heavy water moderated gas cooled reactor
LF	load factor
LFH	load factor including heat
LTS	Long term shutdown
LWGR	light water cooled graphite moderated reactor
MW	megawatt
MW·h	megawatt-hour
NEA	non-electrical application
NPP	nuclear power plant
NSSS	nuclear steam supply system

OF	operation factor
PHWR	pressurized heavy water reactor
PEL	planned energy loss
PI	performance indicator
PRIS	power reactor information system
PRISTA	PRIS-Statistics
PUF	planned unavailability factor
PWR	pressurized water reactor
REG	reference energy generation
RUP	reference unit power
SGHWR	steam generating heavy water reactor
TW·h	terawatt-hour
UA7	unplanned automatic scram rate
UCF	unit capability factor
UCL	unplanned capability loss factor
UEL	unplanned energy loss
US7	Unplanned scram rate
UUF	unplanned unavailability factor
WANO	World Association of Nuclear Operators
WEDAS	web-enabled data acquisition system
XEL	externally caused energy loss
XUF	external unavailability factor

ANNEX
CODES USED IN PRIS OUTAGE REPORTS

The outage coding system clearly refers to statistical objectives and not to an event approach, with detailed description and root cause analyses. It constitutes a first level tool for plant performance analyses and benchmarking.

Detailed definitions of outage codes is in IAEA-TECDOC-1393[2].

1. Outage type

   The outage type is a three-character code. The third character is for unplanned outages only:

   Code_1 description:

   (P) Planned outage due to causes under the plant management control
   (U) Unplanned outage due to causes under the plant management control
   (X) Outage due to causes beyond the plant management control ("external")

   Code_2 description:

   (F) Full outage
   (P) Partial outage

   Code_3 description:

   (1) Controlled shutdown or load reduction that could be deferred but had to be performed earlier than four weeks after the cause occurred or before the next refuelling outage, whatever comes first
   (2) Controlled shutdown or load reduction that had to be performed in the next 24 hours after the cause occurred
   (3) Extension of planned outage
   (4) Reactor scram, automatic
   (5) Reactor scram, manual

2. Outage direct cause codes

   (A) Plant equipment failure
   (B) Refuelling without maintenance
   (C) Inspection, maintenance or repair combined with refuelling
   (D) Inspection, maintenance or repair without refuelling
   (E) Testing of plant systems or components
   (F) Major back-fitting, refurbishment or upgrading activities with refuelling
   (G) Major back-fitting, refurbishment or upgrading activities without refuelling
   (H) Nuclear regulatory requirements

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[2] INTERNATIONAL ATOMIC ENERGY AGENCY, International Outage Coding System for Nuclear Power Plants, IAEA-TECDOC-1393, IAEA, Vienna (2004).

(J) Grid failure or grid unavailability
(K) Load-following (frequency control, reserve shutdown due to reduced energy demand)
(L) Human factor related
(M) Governmental requirements or court decisions
(N) Environmental conditions (flood, storm, lightning, lack of cooling water due to dry weather, cooling water temperature limits, etc.)
(P) Fire
(R) External restrictions on supply and services (lack of funds due to delayed payments from customers, disputes in fuel industries, fuel-rationing, labour strike outside the plant, spare part delivery problems, etc.)
(S) Fuel management limitation (including high flux tilt, stretch out or coast-down operation)
(T) Heat supply (on-site to support next unit or desalination and off-site distribution)
(U) Security and access control and other preventive shutdown due to external threats
(Z) Others

3. Codes of plant systems and components involved

Nuclear Systems

11.00 Reactor and Accessories
11.01 Reactor vessel and main shielding (including penetrations and nozzles)
11.02 Reactor core (including fuel assemblies)
11.03 Reactor internals (including steam separators/dryers — BWR, graphite, pressure tubes)
11.04 Auxiliary shielding and heat insulation
11.05 Moderator and auxiliaries (PHWR)
11.06 Annulus gas system (PHWR/RBMK)
11.99 None of the above systems

12.00 Reactor I&C Systems
12.01 Control and safety rods (including drives and special power supply)
12.02 Neutron monitoring (in-core and ex-core)
12.03 Reactor instrumentation (except neutron)
12.04 Reactor control system
12.05 Reactor protection system
12.06 Process computer
12.07 Reactor recirculation control (BWR)
12.99 None of the above systems

13.00 Reactor Auxiliary Systems
13.01 Primary coolant treatment and clean-up system
13.02 Chemical and volume control system
13.03 Residual heat removal system (including heat exchangers)
13.04 Component cooling system

13.05 Gaseous, liquid and solid radwaste treatment systems
13.06 Nuclear building ventilation and containment inerting system
13.07 Nuclear equipment venting and drainage system (including room floor drainage)
13.08 Borated or refuelling water storage system
13.09 CO_2 injection and storage system (GCR)
13.10 Sodium heating system (FBR)
13.11 Primary pump oil system (including RCP or make-up pump oil)
13.12 D_2O leakage collection and dryer system (PHWR)
13.13 Essential auxiliary systems (GCR)
13.99 None of the above systems

14.00 Safety Systems
14.01 Emergency core cooling systems (including accumulators and core spray system)
14.02 High pressure safety injection and emergency poisoning system
14.03 Auxiliary and emergency feedwater system
14.04 Containment spray system (active)
14.05 Containment pressure suppression system (passive)
14.06 Containment isolation system (isolation valves, doors, locks and penetrations)
14.07 Containment structures
14.08 Fire protection system
14.99 None of the above systems

15.00 Reactor Cooling Systems
15.01 Reactor coolant pumps/blowers and drives
15.02 Reactor coolant piping (including associated valves)
15.03 Reactor coolant safety and relief valves (including relief tank)
15.04 Reactor coolant pressure control system
15.05 Main steam piping and isolation valves (BWR)
15.99 None of the above systems

16.00 Steam generation systems
16.01 Steam generator (PWR), boiler (PHWR, AGR), steam drum vessel (RBMK, BWR)
16.02 Steam generator blowdown system
16.03 Steam drum level control system (RBMK, BWR)
16.99 None of the above systems

17.00 Safety I&C Systems (excluding reactor I&C)
17.01 Engineered safeguard feature actuation system
17.02 Fire detection system
17.03 Containment isolation function
17.04 Main steam/feedwater isolation function
17.05 Main steam pressure emergency control system (turbine bypass and steam dump valve control)
17.06 Failed fuel detection system (DN monitoring system for PHWR)
17.07 RCS integrity monitoring system (RBMK)
17.99 None of the above systems

Fuel and Refuelling Systems

21.00 Fuel Handling and Storage Facilities
21.01 On-power refuelling machine
21.02 Fuel transfer system
21.03 Storage facilities, including treatment plant and final loading and cask handling facilities
21.99 None of the above systems

Secondary Plant Systems

31.00 Turbine and auxiliaries
31.01 Turbine
31.02 Moisture separator and reheater
31.03 Turbine control valves and stop valves
31.04 Main condenser (including vacuum system)
31.05 Turbine by-pass valves
31.06 Turbine auxiliaries (lubricating oil, gland steam, steam extraction)
31.07 Turbine control and protection system
31.99 None of the above systems

32.00 Feedwater and Main Steam System
32.01 Main steam piping and valves
32.02 Main steam safety and relief valves
32.03 Feedwater system (including feedwater tank, piping, pumps and heaters)
32.04 Condensate system (including condensate pumps, piping and heaters)
32.05 Condensate treatment system
32.99 None of the above systems

33.00 Circulating Water System
33.01 Circulating water system (pumps and piping/ducts excluding heat sink system)
33.02 Cooling towers / heat sink system
33.03 Emergency ultimate heat sink system
33.99 None of the above systems

34.00 Miscellaneous Systems
34.01 Compressed air (essential and non-essential / high-pressure and low-pressure)
34.02 Gas storage, supply and cleanup systems (nitrogen, hydrogen, carbon dioxide, etc.)
34.03 Service water / process water supply system (including water treatment)
34.04 Demineralized water supply system (including water treatment)
34.05 Auxiliary steam supply system (including boilers and pressure control equipment)
34.06 Non-nuclear area ventilation (including main control room)
34.07 Chilled water supply system
34.08 Chemical additive injection and makeup systems
34.09 Non-nuclear equipment venting and drainage system
34.10 Communication system
34.99 None of the above systems

35.00 All other I&C Systems
35.01 Plant process monitoring systems (excluding process computer)
35.02 Leak monitoring systems
35.03 Alarm annunciation system
35.04 Plant radiation monitoring system
35.05 Plant process control systems
35.99 None of the above systems

Electrical Systems

41.00 Main Generator Systems
41.01 Generator and exciter (including generator output breaker)
41.02 Sealing oil system
41.03 Rotor cooling gas system
41.04 Stator cooling water system
41.05 Main generator control and protection system
41.99 None of the above systems

42.00 Electrical Power Supply Systems
42.01 Main transformers
42.02 Unit self-consumption transformers (station, auxiliary, house reserve, etc.)
42.03 Vital AC and DC plant power supply systems (medium and low voltage)
42.04 Non-vital AC plant power supply system (medium and low voltage)
42.05 Emergency power generation system (e.g. emergency diesel generator and auxiliaries)
42.06 Power supply system logics (including load shed logic, emergency bus transfer logic, load sequencer logic, breaker trip logic, etc.)
42.07 Plant switchyard equipment
42.99 None of the above systems

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