Recent Insights from the International Common Cause Failure Data Exchange (ICDE) Project

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Abstract: CCF events can significantly impact the availability of safety systems of nuclear power plants. For this reason, the ICDE Project was initiated by several countries in 1994. Since 1997 it has been operated within the OECD NEA framework and the project has successfully operated over seven consecutive terms (the current term being 2019-2022). The ICDE Project allows multiple countries to collaborate and exchange common-cause failure (CCF) data to enhance the quality of risk analyses, which include CCF modelling. Because CCF events are typically rare, most countries do not experience enough CCF events to perform meaningful analyses. Information combined from several countries, however, have yielded sufficient data for more rigorous analyses.

The ICDE project has meanwhile published eleven reports on collection and analysis of CCF events of specific component types (centrifugal pumps, emergency diesel generators, motor operated valves, safety and relief valves, check valves, circuit breakers, level measurement, control rod drive assemblies, heat exchangers) and five topical reports on a number of different topics including intersystem common cause failure events while three additional topical reports are under preparation.

The ICDE project has changed the view of CCFs a great deal. Many insights would not have been possible to identify without a deep plant data collection and combining information from many sources. For instance, determination of the fact that the most common cause of complete CCFs seems to be human action as a part of operation or design, rather than manufacturing deficiencies, would not have been possible without deep plant data collection and combining of information from many sources. This paper presents recent activities and lessons learnt from the data collection and the results of topical analyses on Pre-initiator human failure events (HFEs). In addition, the objectives and scopes of the ongoing analyses are presented.

1 INTRODUCTION

Common-cause-failure (CCF) events can significantly impact the availability of the safety system of a nuclear power plant (NPP). In recognition of this, CCF data is systematically being collected and analysed in several countries. Due to the low probability of occurrence of such events it is not possible to derive a comprehensive evaluation of all relevant CCF-phenomena only from the operating experience from one individual country. Therefore, it is necessary to make use of the international operating experience from other countries using similar technology.

The usage of international NPP operating experience with CCF requires a common understanding what CCFs are and how to collect data about them. To develop such a common understanding an international common-cause failure working group was founded in 1994. This working group has elaborated the project International Common-Cause Failure Data Exchange" (ICDE).

2 ICDE OBJECTIVES AND OPERATING STRUCTURE

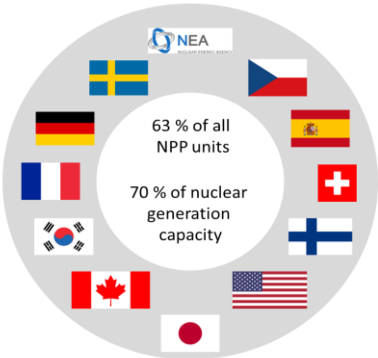
The ICDE-project pursues two main aims, i.e., collect qualitative and quantitative information about CCFs in NPP, and analyse the collected data and distribute the gained insights about CCFs and methods to prevent CCFs as reports to the concerned professional audience. The objectives of the ICDE project as expressed in the *terms and reference* are to:

- provide a framework for multinational co-operation;

- collect and analyze CCF events over the long term so as to better understand such events, their causes, and their prevention;
- generate qualitative insight into the root causes of CCF events, which can then be used to derive approaches or mechanisms for their prevention or for mitigation of their consequences;
- establish a mechanism for efficient gathering of feedback on experience gained in connection with CCF phenomena, including the development of defenses against the occurrence, such as indicators for risk based inspections; and
- generate quantitative insights and record event attributes to facilitate quantification of CCF frequencies in member countries; and
- use of ICDE data to estimate CCF parameters.

The ICDE-project is based upon a broad international cooperation (**Error! Reference source not found.**): The countries which participate in the ICDE project operate 281 NPP units which is about 63 % of all NPP units worldwide. With a generation capacity of 275.864 MW these 281 units provide more than 70 % of the worlds' total nuclear generation capacity. The number of 281 units comprises 191 PWR, 68 BWR and 23 PHWR so the majority of NPP types is covered.

Fig 1. International cooperation and operating experience



3 ICDE ORGANISATION

The central body of the ICDE project is the ICDE Steering Group (SG) in which each participating country is represented by its national coordinator. The SG controls the project, assisted by the NEA project secretary and the Operating Agent (OA). The OA is responsible for the database and consistency analysis. The NEA Secretariat is responsible for administering the project. The SG meets twice a year on average.

The ICDE Steering Group has the responsibility to:

- Secure the financial (approval of budget and accounts) and technical resources necessary to carry out the project,
- Nominate the ICDE project chairman, to define the information flow (public information and confidentiality),
- Approve the admittance of new members,
- Nominate project task leaders (lead countries) and key persons for the Steering Group tasks,
- Define the priority of the task activities and to monitor the development of the project and task activities,
- Monitor the work of the OA and the projects quality assurance and prepare the legal agreement for project operation.

In most countries, the data exchange is carried out through the regulatory bodies, with the possibility to delegate it to other organisations. To ensure that the data collection is performed in a consistent and comparable way in all participating countries the SG has developed and approved "coding guides" which define the format and extend of the collected information. The ICDE database is available for signatory organisations.

The project is based upon the willingness of the participants so share their operating experience; to encourage that, the participation organisations get access to the database in accordance with their own contribution to the data collection. The relevant criterion is not the total amount but the completeness of the contributed data. For example, when a country submits its operating experience with emergency diesel generators (EDG) from 1990-2010 it will get access to the complete operating experience with EDGs in that time period, irrespective of the number of NPPs that are operated in that country.

The project has successfully completed the following phases:

- Phase One: 1994 to 2000.
- Phase Two: 2000 to 2002.
- Phase Three: April 1, 2002 to March 31, 2005.
- Phase Four: April 1, 2005 to March 31, 2008.
- Phase Five: April 1, 2008 to March 31, 2011.
- Phase Six: April 1, 2011 to December 31, 2014.
- Phase Seven: January 1st 2015 to December 31, 2018.

The project is currently in the phase VIII (Agreement of OECD/NEA) which will cover the period from January 2019 to December 2022. Member countries under the current phase and the organisations representing them in the project are: Canada (CNSC), Czech Republic (UJV), Finland (STUK), France (IRSN), Germany (GRS), Japan (NRA), Netherlands (ANVS), Sweden (SSM), Switzerland (ENSI) and the United States (NRC). The participation of other NEA member countries is always possible and welcome.
OECD/NEA is responsible for administering the project according to OECD rules. This means secretarial and administrative services in connection with the funding of the Project such as calling for contributions, paying expenses incurred in connection with the Operating Agent and keeping the financial accounts of the Project. NEA appoints the Project Secretariat. To assure consistency of the data contributed by the national co-ordinators the project operates through an Operating Agent (OA). The OA verifies whether the information provided by the national coordinators complies with the ICDE Coding Guidelines. Jointly with the national coordinators, it also verifies the correctness of the data included in the database. In addition, the OA operates the databank.

The SG has established a comprehensive quality assurance program: The responsibilities of participants in terms of technical work, document control and quality assurance procedures as well as in all other matters dealing with work procedures, are described in the ICDE Quality Assurance Programme (Project report ICDEPR05).

4 TECHNICAL SCOPE OF THE ICDE ACTIVITIES

4.1 Scope

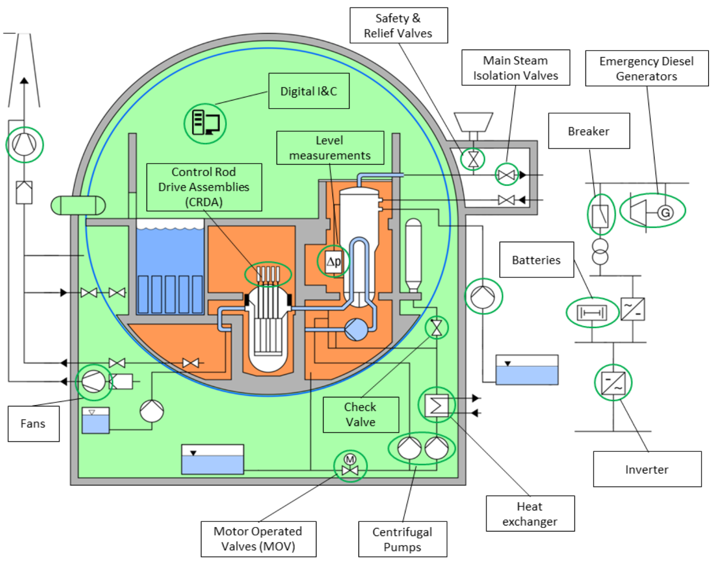
The ICDE operates with a clear separation of the collection and analysis activities. The analysis results mostly in qualitative CCF information. This information may be used for the assessment of 1) the effectiveness of defenses against CCF events and 2) the importance of CCF events in the PSA framework. Qualitative insights on CCF events generated are made public as CSNI reports. The member countries are free to use the data in their quantitative and PSA related analyses.

It is intended to include in ICDE the key components of the main safety systems. The data collection and qualitative analysis result in a quality assured database with consistency verification performed within the project. The responsibilities of participants in terms of technical work, document control, and quality assurance procedures, as well as in all other matters dealing with work procedures, are described in the special ICDE Quality Assurance Program and the ICDE operating procedures.

ICDE activity defines the formats for collection of CCF events in order to achieve a consistent database. This task includes the development and revision of a set of coding guidelines describing the classification, methods, and documentation requirements necessary for the ICDE database(s). Based on the generic guidelines, component specific guidelines are developed for all analyzed component types as the Project progresses. These guidelines are made publicly available as a CSNI technical note [1].

The scope of ICDE is intended to include the key components of the safety relevant systems. Within the data collection different types of safety relevant components are distinguished. For each component type an individual "coding guide" is developed by the steering group which defines how the data collection for that specific component type should be performed (see section **Error! Reference source not found.** for details). An overview of the currently* covered component types is shown in Figure 1. New component types are added in case there is a corresponding interest of a participating country.

Figure 1 Technical scope of ICDE activities



4.2 Definition of Common Cause Events

Common Cause Failure Event: A dependent failure in which two or more component fault states exist simultaneously, or within a short time interval, and are a direct result of a shared cause.

ICDE data collection also includes potential CCF events, or ICDE Events, which include impairment of two or more components (with respect to performing a specific function), which exists over a relevant time interval and is the direct result of a shared cause.

4.3 Publications

The ICDE Steering Group prepares publicly available reports containing insights and conclusions from the analysis performed whenever major steps (i.e. analysis of a dataset for a certain component type like check valves) of the Project have been completed. The ICDE Steering Group assists the appointed lead person in reviewing the reports. Following this, an external review is provided by the NEA Committee on Safety of Nuclear Installation (CSNI). ICDE reporting also includes submitting papers to suitable international conferences like PSAM and PSA, and to journals. The intention is to make the lessons learnt known to the large nuclear safety audience.

The ICDE time schedules define the milestones of data collection tasks for each analyzed component group. The time schedule is reassessed and revised at each ICDE Steering Group meeting. The work starts with drafting the guidelines, getting comments, making a trial data collection, approving the guidelines, making the data exchange, resolving the remaining problem cases, and reporting.

* As of 31 March, 2022

Generally, it takes between 1.5 and 2 years from the first guideline draft to commence the data exchange itself. Furthermore, from that point it takes about 2-3 years to approving the final report. Thereafter, new exchange rounds (database updating) are possible.

The database contains general information about event attributes like event cause, coupling factor, detection method, and corrective action taken. As for the current phase VIII (March 2022), data analysis and exchange have been performed for Centrifugal Pumps, Diesel Generators, Motor-operated Valves, Safety Relief Valves, Check Valves, Batteries, Level Measurements, Switching Devices and Circuit Breakers, Control Rod Drive Assemblies, Heat Exchangers, Fans, Main Steam Isolation Valves and Digital Instrumentation and Control equipment (I&C).

4.4 Published ICDE component reports

Public final reports for Centrifugal Pumps, Diesel Generators, Motor-operated valves, Safety & Relief Valves, Check Valves, Batteries, Level Measurements, Switching Devices and Circuit Breakers, Control Rod Drive Assemblies, and Heat Exchangers have been issued in the NEA CSNI series [2]-[13], (see also: http://www.nea.fr/html/nsd/docs/indexcsni.html). Also, an updated report on Centrifugal Pumps has been issued [11].

4.5 Data collection overview

An overview of the database content[†] with the number of CCF events and the number of complete[‡] and partial[§] CCF events for each component type is given in Table 1. Events are further analyzed and categorized according to the ICDE failure analysis guidelines.

Table 1 Data collection overview

Component Type	Total CCF Event Count	Contribution to total CCFs	Complete CCF	Partial CCF	Group Years
Centrifugal Pumps	444	21.5	47	44	39,512
Diesels	348	16.8	33	21	6,442
Safety and Relief Valves	296	14.3	22	44	17,019
Motor Operated Valves	194	9.4	10	37	31,565
Control Rod Drive Assembly	180	8.7	4	27	7,515
Level measurement	169	8.2	9	32	10,568
Check valves	118	5.7	12	26	23,677
Breakers	116	5.6	6	29	25,924
Battery	87	4.2	5	2	6,099
Heat Exchanger	58	2.8	4	1	16,821
Fans	32	1.5	3	0	12,321
Main Steam Isolation Valves	13	0.6	1	4	3,697
Cross-component CCF	5	0.2	0	0	-
Digital I&C	4	0.2	2	0	41
Inverters	4	0.2	2	0	331
Grand Summaries	2068	100%	160	267	201,533

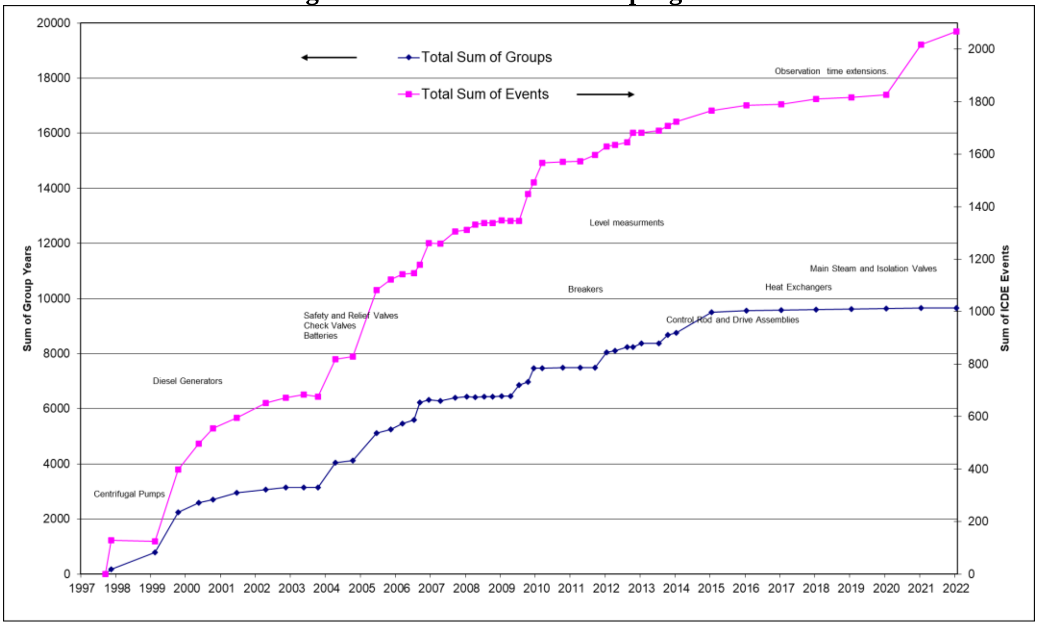
The participating countries are gradually extending the data with more observation time and events. The frequency of observing an ICDE event in an observed population (CCF component group) is approximately 0.015/year (or <2E-6/h). This low frequency in itself justifies an international collaboration on this issue. Figure **2**3 shows the data collection progress, i.e. when data has been

[†] As of 31 March, 2022.
[‡] Complete CCF: A common-cause failure in which all redundant components are failed simultaneously as a direct result of a shared cause (i.e., the component impairment is 'Complete failure' for all components and both the time factor and the shared cause factor are 'High').
[§] Partial CCF: A complete failure of at least two components, but not all of the exposed population, where these fault states exist simultaneously and are the direct result of a shared cause.

synchronized and exchanged and how the database has been expanded with new components and data exchanges over the years.

The chronological sequence of the data collection is shown in Figure 2. The graph shows how new component types were added over time as well as the continuous data collection for the existing component types.

Figure 2 ICDE data collection progress



5 LESSONS LEARNT

Lessons learnt cover lessons about reporting of project results as well as technical insights from topical analysis of ICDE data. This experience has been collected in a failure analysis guide that is applied when a new component report is produced or if a new topical report is prepared. This section presents an overview of the guide and recent or ongoing applications.

5.1 Failure analysis guideline

When analyzing events, the approach to perform a failure analysis by examining failure mechanism categories, failure mechanism sub categories, and failure cause categories, and their correlations, proved to be very successful. Evaluations following this concept have revealed insights that would otherwise not have become evident. By incorporating failure analysis fields in the ICDE database, this assessment is as transparent as any other assessment being performed. The development of failure analysis provides:

- Appropriate transparency and reproducibility between component reports and the database. It is further expected that the opportunity to find new perspectives and to engage in new development of data analysis will increase as the database content is extended with failure analysis.
- Additional aspects when conducting workshops.
- Detailed analyses of failure mechanisms that will provide valuable insights for improving defenses against the occurrence of CCF events.

An approach has been developed to perform failure analysis focused on failure mechanisms. Failure mechanisms should be considered as consequences to the failure cause. Therefore, the following steps should be performed in chronological order when performing a failure analysis:

1. Describe the failure mechanism in a few words. The failure mechanism is a history describing the observed events and influences leading to a given failure. Aspects of the failure mechanism could be deviation or degradation or a chain of consequences.

2. Specify the failure mechanism category. A failure mechanism category is a group of similar failure mechanism sub-categories, e.g., for Diesels, the Failure mechanism category "Engine damage or problems" has the following failure mechanism sub-categories
   - "Starting air or air supply valve/distributor damage",
   - "(Potential) damage of rotating or stationary parts (bearings, crankcase high pressure in crankcase etc.)",
   - "Combustion chamber problems (e.g., cylinder, piston, fuel injection nozzle, and pump damage)",
   - "Coupling (between engine and generator) damage",
   - "Combustion/Charging air problems (e.g. air intake, turbocharger damage)"
   - "Other, for example faulty operator action or maintenance error"
3. Specify the failure mechanism sub-category. Failure mechanism sub-categories are coded component-type-specific observed faults or non-conformities that have led to an ICDE event.
4. Specify the failure cause category. Failure cause categories are potential deficiencies in operation or deficiencies in design, construction, and manufacturing that made it possible for a CCF event to occur.

A list of the failure mechanism descriptions can be an easy, and yet efficient, way to summarize the type of failures for a certain scope of events.

5.2 Lessons Learned from Common-Cause Failures of Motor-Operated Valves (172 events)

This report is an update of the ICDE report on MOVs CCF events published in 2001 [4] and which analysed 87 events. Since that time, the ICDE project has continued collection of MOVs events. The database now includes 172 events spanning a period from 1980 through 2017. Therefore, it was decided to make an update of the report.

The report is mainly intended for designers, operators and regulators to provide insights in the type of failure mechanisms and causes of MOV events in the ICDE database. These insights can improve the understanding of failure mechanisms and phenomena involved and their relationship to the CCF root cause. The analysis includes assessment of the following parameters; event cause, coupling factor, corrective action, CCF root cause, event severity, detection method and latency. Notable observations of this analysis were:

- The CCF root causes "solely or predominant design" and "solely or predominant procedures" were equally common, about 45% respectively. About 10% was due to deficiencies in human actions.
- Design deficiencies are slightly more common among the severe events (raising the share to 55%). The less severe events are more commonly caused by deficiencies in procedures (raising it to 57%).
- The main problem of the severe events was related to electrical I&C design issues, more specifically due to setpoints exceeding the torque switch limit. I&C failures appear more likely than other types of failure mechanisms to result in severe CCF events that completely fail multiple components in a group.
- Failures or component degradations related to wrong or drift of setpoints are very common, both for severe and less severe events. about 52% of the events with an operational failure cause was caused by operator performance errors, such as incorrect adjustments and tightening. About 10% of the events involved leakage of the main valve, mainly due to an operational failure cause and often due to an insufficient ageing management program. About

17% of the events had a latent time factor of more than half a year, which may indicate a too long test interval of the components or inadequate test procedures.

The analysis of the events gives the following qualitative insights, lessons learned and recommendations in the type of failure mechanisms and causes of MOV events in the ICDE database:

- Deficiencies in the design tend to result in more severe events for MOVs and most problems are caused by electrical I&C design issues with the most common issue involving setpoints exceeding the torque switch limit. Recurrent control of setpoint and verification of these after test and maintenance have the possibility to reduce the risk of CCF and should be implemented. Without such surveillance and control, these types of problems tend to develop into severe CCF events, as seen in the data set.
- Degradation of components until failure occurs slowly. Consequently, adequate operational procedures, ageing management and operational actions should be implemented as they have the possibility to prevent events from happening at all or detect the degradation before complete failure of the component occurs.
- Operator performance errors result in severe events. To prevent such errors, it is vital to have adequate procedures, written work plans, training of personnel and in general to have a well-established safety culture. Also, verification of operability after actions has to be performed on a structured basis as it has an important role to minimize such failure causes.
- A sufficient ageing management program in combination with frequent inspections, to detect wear and degradation of valve internals, should be implemented as it can prevent the occurrence of leakage of valves.

5.3 Topical reports

Topical analyses have been performed or are under preparation for a number of topics:

- External Factors, [[14.]] (64 events)
- Diesels all affected [[15.]] (143 events)
- Plant Modifications [18] (53 events)
- Improving Testing [19] (2019, 59 events)
- Multi-unit events [20] (2019, 87 multi-unit events)
- Inter-system dependencies [21] (25 events)
- Pre-initiator human failure (HFE) ICDE events [22] (51 events).

In this paper, the recently completed topical analysis results of topical analysis Pre-initiator human failure ICDE events and External Factors events are discussed in detail. In addition, the objectives and scope of the ongoing analysis is presented.

5.3.1 Pre-initiator human failure ICDE events [22] (51 events)

The goal of the “Pre-initiator human failure event (HFEs)” topic was to analyze event that may impact the availability of components in accident preventing/mitigating systems and is caused by inappropriate actions or human inactions, such as misalignments and miscalibrations.

The topical report included 51 common-cause pre-initiator HFEs events. All the included events were complete CCFs. The event set also includes important Intersystem HFEs and Multi-unit HFEs.

The engineering analysis of pre-initiator HFEs addressed:

- The involved act that determines the “cause” or “trigger” of the human failure event.
- The performance shaping factors (PSFs) that impact the pre-initiator HFEs.

- The latency of the event until failure or detection of degraded component state.

Pre-initiator HFEs events were observed for a wide range of component types. Centrifugal pumps, followed by Emergency Diesel Generators, Motor-Operated Valves (MOVs) and Safety and Relief Valves were most common component types, i.e., 77% of events involved these types. The event set also includes important Intersystem HFEs and Multi-unit HFEs. The event causes human actions (26%) and procedures (24%) were almost equally common. The most common coupling factor was operational followed by maintenance/test procedure. The most common corrective action was general administrative/procedure controls. For about 76% of the events, the concluded CCF root cause was deficiencies in procedures. Also, almost 50% of all events had all three root cause aspects related to procedures. The most common detection method was monitoring in the control room, followed by test during operation and annual overhaul.
The lessons learned from the engineering aspects analysis of the pre-initiator HFEs and the resulting recommendations are as follows:

– Deficiency in the procedure was the main CCF root cause for the complete common-cause pre-initiator HFEs (76%). However, faulty human actions are often involved in the procedures and therefore is the procedure itself, not a self-standing sufficient defence to avoid HFEs. Factors such as training of personnel, safety culture and plant management have an important role to prevent HFEs. Indeed, about 18% of the HFEs were marked as safety culture issues.

– The most common acts were corrective/preventive maintenance followed by surveillance testing.

- The most important PSFs were procedure, training and written work plan, with emphasis on the adequacy of the procedure itself but also on the planning of the work as well as the training of the personnel.

The analysis also identified possible defences/improvements for the HFEs that could have prevented all components to fail. These possible defences do mainly include improvements of surveillance of the components, better maintenance or test procedure and different types of improvement of the management system of the plant.

- The analysed complete HFEs shows the importance of:
    - Quality assurance of procedures, e.g., ensure the scope, adequacy and the know-how of the procedures. The plant management has an important role to ensure this through training of personnel, QA of processes and safety culture.
    - Adherence to procedures and written work plans in a safe manner. E.g. do not conduct tests in the wrong operational mode or simultaneously.
    - Verification of operability, after maintenance work (installations, modifications and replacements) and after testing (e.g. ensure correct positions of breakers, switches etc.).
    - Adequate training of the personnel involved regarding maintenance and inspections that emphasizes the importance of quality management and safety culture at all organizational levels
- The pre-initiator HFEs from the ICDE database provides valuable insights into dependencies since many of these dependencies are not typically modelled in a HRA.

5.3.2 External Factors, [[14.]] (64 events)

An external factor event is a CCF event or CCF fragility (impairment) related to external or environmental factors or an event directly caused or triggered by such factors (e.g., weather events or conditions external to the plant). This topical report is an update of the ICDE topical report on External factors published in 2015 [14]. It summarizes the results of two data analysis workshops performed by the ICDE projects steering group.

The objective of this report was to analyze CCF event related to external factors and to develop qualitative insights into the type of external factor events in the ICDE database. A total of 64 of common-cause failure events due to external factors were assessed. The scope of the “external factor” topic included not only storms, hurricanes, and severe weather events but also other environmental conditions, such as, high outdoor temperatures and excessive algae growth. The data analysis included an assessment of the event parameters; event cause, coupling factor, corrective action, CCF root cause, event severity and detection method.

The most noteworthy aspects of the event parameters are:

- The major observed event cause is “Abnormal environmental stress” (42%) and it is relatively over-represented with a factor of 9 compared to the complete ICDE database, i.e., abnormal environmental stress is more common seen in an external factor event.
- For about 31% of the events, the concluded CCF root cause was solely or predominant design, where environmental aspects significantly contributed. An equally large share of the events was determined to be “Environmental trigger” events, i.e., events with a non-foreseen environmental cause.

The engineering analysis addressed the “cause” or “trigger” of the external factor event, expressed by different hazard groups and classification of their causes and areas of improvement to prevent the events from happening again.

The lessons learned from the engineering aspects analysis of the external factor events and the resulting recommendations are as follows:

- Biological infestation is often a slow developing failure mechanism. It is important to ensure adequate procedures for cleaning of strainers, tubes and plates, and to have a backflush capability. Also, the monitoring capability (e.g., control of flow rate and temperature conditions) is a very important aspect, especially during periods when marine growth occurs.
- Hazards related to debris can be avoided in some case with an improved design of strainers. However, sufficient defences to avoid clogging due to heavy debris are difficult to achieve.
- For a large portion of the events related to degradation due to sand intrusion in the system, monitoring in combination with maintenance and operational practices may result in detection of degradation before failure of the components. Also, an adequate ageing management program could have prevented several events.
- Biological infestation and underwater debris in the water intake are likely to affect multiple units since the intake is often shared between the units.
- To mitigate meteorological effects, a careful evaluation of the system design with consideration of operational experience from events triggered or caused by for example freezing effects, blockage of air/ventilation intakes is recommended. Also, events during periods with low sea- or river temperatures, the importance of monitoring systems dependent on the water intake are vital.
- No experience from seismic events exists in the ICDE data except for one event which relates to a suspected seismic fragility.

The results of this analysis may serve as input for an in-depth review of the methods and assumptions used in external hazards PRA and to support the identification of possible external factors which may have low frequencies but large consequences.

5.4 Ongoing analyses

5.4.1 Safety culture (ongoing)

Data analysis and review of CCF data from the ICDE project has identified severe events with evidence of Safety Culture (SC) deficiencies as the main event cause. Hence, the ICDE projects steering group performed three data analysis workshops to look further into such events.

The purpose of this report is to obtain insights into how to best identify and classify safety culture issues to develop a SC framework based on operating experience.

This topical report will summarize the results of these workshops. The report will include a total of up to 145 safety culture events with a range of identified deviations from a healthy safety culture. The screening of SC events will look especially at "all affected" **(i.e. all components in the group are impaired) pre-initiator human failure events (HFEs). An HFE is an event caused by human action or procedures coupled with an organisational coupling factor. The harmonized safety culture model (SCM) framework, developed by IAEA and WANO, will be used as basis for classification of the events.

5.4.2 ICDE quantification procedure and data interpretation in component-specific quantitative applications (ongoing)

This report will address the general procedure and data interpretation for quantification with ICDE data. From the quantitative application, there are several comments that need to be addressed and resolved. The report will explore and resolve those issues and demonstrate the use of ICDE data. Issues of special focus are inhomogeneity in the impact vectors and removing older data (for example, limit to year 2000 and later).

6 DISCUSSION

What can be said is that the ICDE has changed the view of CCFs a great deal. For instance, determination of the fact that the most common cause of complete CCFs seems to be human action as a part of operation or design, rather than manufacturing deficiencies, would not have been possible without deep plant data collection and combining of information from many sources.

Maybe the most important generic lesson is that it is worth forming specialized data exchange projects like ICDE. This, however, requires first the will of several countries to form a critical mass by combining their operating experience efforts; second, it requires national efforts to collect lower level data than those made publicly available as LER or IRS reports; third, it requires the forming of a legal framework to protect this proprietary data and, fourth, a long term commitment to consistently continue and develop the activity.

OECD NEA and ÅF industry, as the Operating Agent, have provided the means to run the international dimension of the ICDE; however, national efforts are the key to the success of any project that relies on operating experience. The success of the ICDE has given a birth to several similar types of projects, among which are the CODAP for pipe failure events and the OECD-FIRE for NPP fire events.

More information about ICDE may be obtained by visiting the CSNI report site: http://home.nea.fr/html/nsd/docs/indexcsni.html, or the Operating Agent website: https://projectportal.afconsult.com/ProjectPortal/icde or by contacting the responsible OECD administrator.

References

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[2.] Collection and analysis of common-cause failure of centrifugal pumps [NEA/CSNI/R(99)2], September 1999. Replaced with [NEA/CSNI/R(2013)2],

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[4.] Collection and analysis of common-cause failure of motor-operated valves [NEA/CSNI/R(2001)10], February 2001. Replaced with NEA/CSNI/R(2021)7 ICDE Report: Lessons Learned from Common-Cause Failures of Motor Operated Valves.

** All affected is defined as an event where all component in the common cause component group are impaired to some extent, i.e., complete, degraded or incipient impairment.

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