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WANO

# MANUAL

WANO MANUAL

MN | 01

January 2018

## Operating Experience Sub-Programme

*Revision 8*

GENERAL DISTRIBUTION

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**APPLICABILITY**

THIS WANO MANUAL APPLIES TO ALL REACTOR TYPES

GENERAL DISTRIBUTION

# Manual | MN 01
# Revision History

| Author | Date | Reviewer | Approval |
|---|---|---|---|
| Samvel Ghazaryan | 30 November 2014 | Riccardo Chiarelli | Jo Byttebier |
| **Reason for Changes:** this is revision 6 of the reference manual. This revision incorporates suggestions and comments from all regional centres on the OE Reference Manual. | | | |
| R. Chiarelli, B. Alvarez | 22 March 2016 | Riccardo Chiarelli | Kris Mertens |
| **Reason for Changes:** this is revision 7 of the reference manual. This revision incorporates suggestions and comments from all regional centres on the OE Reference Manual. Main changes include additional reporting and significance criteria for units under construction and in decommissioning. In addition, significance criteria for units in operations have been amended for further clarification. Finally, the confidentiality classification has been changed to 'general distribution'. | | | |
| PACT | 15 December 2017 | Riccardo Chiarelli | Kris Mertens |
| **Reason for Changes:** this is revision 8 of the reference manual. This revision incorporates suggestions and comments from all regional centres on the OE Reference Manual. Main changes include a clarification of the significance level for the events that need to be reported to WANO. | | | |

# Manual | MN 01
# Operating Experience Sub-Programme

## CONTENTS

# Manual | MN 01
# Purpose and Reference

- The purpose of this manual is to provide a ready reference and assistance to those personnel involved in reporting events to WANO. This manual is available electronically on the WANO website.
- The WANO Programme Guideline WPG 02, *Operating Experience*, provides overall policy and guidance for this programme.

# Manual | MN 01
# 1. Criteria for Event Reporting

PROBLEMS IN FINDING EXACT CRITERIA TO MATCH THE BELOW CATEGORIES SHOULD NOT PREVENT REPORTING EVENTS INVOLVING STATION SAFETY OR RELIABILITY THAT, DUE TO THEIR CAUSES OR CONSEQUENCES, ARE JUDGED BY A MEMBER TO BE OF INTEREST TO OTHER MEMBERS.

MEMBERS ARE ENCOURAGED TO ATTACH APPARENT OR ROOT CAUSE ANALYSES IN THE EVENT REPORT. WHEN APPLICABLE, INCLUDE DETAILS ABOUT AFFECTED EQUIPMENT, COMPONENT AND SUB-COMPONENT. OTHER MEMBERS COULD LEARN AND BENEFIT FROM THAT INFORMATION.

IF THERE IS UNCERTAINTY WHETHER OR NOT AN EVENT MEETS THE REPORTING CRITERIA, THE EVENT SHOULD BE REPORTED.

The following categories and criteria with links to four levels of significance are established to help determine what events members should report to WANO as part of the information exchanged in the operating experience sub-programme. The highest priority should be given to reporting all Significant and Noteworthy events. Reporting of Trending events should be the next priority followed by other events which have the least priority.

## Unusual station transients or events

### Significant events

A change to station or unit operating conditions resulted in or involved any of the following:

1. An automatic or manual reactor scram was required, and the need for operation of one or more safety systems existed, such as emergency core cooling, primary loop overpressure protection or the extended use of emergency electrical power systems.
2. The ability to remove decay heat from the reactor or spent fuel pool was lost, such as during a loss of electrical power or decay heat removal capabilities; and restoring capabilities were challenged.
3. Unusual actions were needed to manage the event because the necessary actions were not specified in abnormal or emergency operating procedures, or because the situation was misdiagnosed by the operators.
4. The transient inhibited the ability of personnel to control or reduce the severity of the event or its consequences. It evolved in a way that was different from the safety analysis or not adequately covered by the operating procedures which affected proper control of safety functions and/or included multiple safety-related equipment malfunctions and/or involved conditions that severely inhibited the personnel’s actions to reduce the severity of the event.

5. A reactivity control event resulted in the reactor reaching or exceeding 103% of the rated power by technical specifications.

6. Events such as a failure of two or more redundant components, fundamental misunderstanding of performance or safety requirements, or non-conservative decisions that reduced nuclear safety margin.

**Noteworthy events**

7. An event with the potential for loss of reactivity control due to failure to monitor or control core or stored nuclear fuel.

8. An event resulted in the reactor reaching or exceeding 102% of the rated power by technical specifications.

9. Complete loss of offsite power in a situation when both the main and auxiliary offsite power supplies are required.

10. The ability to remove decay heat from the reactor or spent fuel pool was lost, such loss of required train of decay heat removal capability. If the cooling water temperature increases more than 10°C, the event could be considered Significant.

11. Substantive deficiencies in design, analysis, operation, maintenance, testing, procedures or training which has the potential to lead to a significant event.

**Trending events**

12. An automatic or manual reactor scram was required, including scrams during start-up or shutdown, whether the reactor is critical or not when all rods were not fully inserted in the core. Do not report reactor scrams that are required by normal shutdown or test procedures.

13. An unplanned reactor shutdown regardless of the power level when the event occurs. For example, a component malfunction during start-up results in the reactor having to be shut down.

14. A turbine generator trip, automatic or manual, required because of entry into an abnormal or emergency operating procedure. Do not report turbine generator trips that are required by normal shutdown or test procedures.

15. An event that causes an unplanned reactor or turbine power decrease of 10% or more. Do not report power changes required for load following or testing, such as turbine valve movement testing or requests to reduce or increase power by the grid operator, unless extenuating or unusual circumstances result from the action.

16. An event that results in an outage being extended for 48 hours or greater due to identified deficiencies in design, maintenance or testing that may result in challenges to nuclear, industrial or radiological safety, reduced safety margin(s) or station reliability.

17. An unplanned loss of production equivalent to one day or more of full power operation.

18. An event that results in an unexpected increase in reactor power.

19. An event that results in unplanned entry into a limiting condition of operation or its equivalent.

20. An event that causes an emergency diesel generator or gas turbine used to provide emergency power to become inoperable or unavailable, without any further consequence.

21. An event that results in entry into emergency operating procedure.
22. An event that results in unplanned partial loss of offsite power with no extenuating circumstances.
23. Intentional and unintentional breach of technical specifications that are required to be reported to the regulator.
24. Potential blockage or fouling of safety-related cooling systems when materials smaller than the intake screen mesh size enter plant systems.
25. Shortfalls in activities with significant risks such as event classifications, timely notifications and protective action recommendations.
26. Fire events that result in visible flaming, evidence of prior flaming, or charring. Events that only involved overheating, steam leaks, smouldering receptacle cans, or unfounded odours are not required to be reported as fire events.
27. Fire events that involve the use of manual fire suppression activities or valid activation of an automatic fire suppression system. False or spurious actuations or alarms do not require reporting as fire events.
28. Fire events that involve arcing or arc flash that cause damage to the device or component itself or to adjacent equipment.
29. Clearance or tagging errors, including omissions or mistakes identified as part of a tagout walkdown, clearances lifted with employees signed on for work, and other issues with the potential to cause damage of important equipment damage, personnel injury or spread contamination.
30. Deficiencies exist in areas such as design, analysis, operation, maintenance, testing, procedures or training that result in challenges to nuclear, industrial or radiological safety, or reduce station reliability.

**Other events**

31. A half or partial scram occurs.
32. Any unplanned reactor scram signal occurs with fuel in the core when control rods are fully inserted, whether manual or automatic.
33. An event that results in an outage being extended for less than 48 hours.
34. Fires of a minor nature that do not affect safety-related components or result in entry into the emergency plan.
35. Events that have an adverse impact on intake structures, systems and components, such as an accumulation of aquatic life (algae, seaweed and other grasses, mussels, jellyfish, shrimp and fish), frazil ice formation, and sand and silt deposits.

## Safety system malfunctions or improper operations

**Significant events**

A substantial reduction of safety margin was encountered due to limited or lost capability of a safety system to perform its function during the event, due to any of the following:

36. Equipment, such as a pump, failed to start or continue running as required.

37. Actuation circuitry, or the logic to actuate equipment, failed to perform as required.

38. Equipment failed to perform its intended function because of alignment or calibration set-point errors, such as valves being out of position, resulting in problems.

39. Improperly operated equipment or actions by control room operators, such as premature termination of a transient response, results in increasing the severity of a transient.

40. Damage from lightning, physical impact from other equipment, corrosion, flooding, fire or support system failures, can result in or increase the severity of a transient.

**Noteworthy events**

41. Safety system malfunctions or improper operations result in the loss of a safety function without further consequences. For example, a loss of all low pressure injection occurs – not just the loss of one low pressure injection pump.

**Trending events**

42. An unplanned activation of a reactor safety system.

43. Malfunctions or events adversely impacting the operability or availability of a safety component.

44. Component mispositioning, including valves, switches, and locking devices within safety-related systems.

## Major equipment damage

**Significant events**

45. An event causing replacement or extensive repair to major equipment, such as steam generator, turbine or reactor coolant pump. Does not include other equipment such as transformers unless further complications followed.

**Noteworthy events**

46. An event that results in an outage being extended for at least 10 days or a loss of at least 10 days of effective full power operation with identified substantive deficiencies in design, maintenance or testing which has the potential to lead to a significant event.

**Trending events**

A malfunction that results in damage to major station equipment with the following impact:

47. An unplanned outage or operation at reduced power level is required for more than 48 hours of equivalent full power operations with identified deficiencies in design, maintenance or testing that may result in challenges to nuclear, industrial or radiological safety, reduced safety margin(s) or station reliability.

48. Unavailability or loss of a large power transformer.

## Excessive radiation exposure, contamination or severe personnel injury

### Significant events

An incident involving and impacting personnel that led to any of the following:

49. Unplanned whole-body dose exposure to ionising radiation of an individual that exceeds the regulatory value.

50. A work-related accident that resulted in a fatality or a permanently disabling injury (such as loss of a limb).

51. Unplanned area dose rate of 1 Sv/h (100 rem/h) or higher in an accessible area.

### Noteworthy events

52. Unplanned whole-body dose exposure to ionising radiation of individual that reaches or exceeds 50% of the regulatory value.

53. Event with a strong potential for significant radiation exposure.

54. Unplanned area dose rate of 50mSv/h (5 rem/h) or higher in an accessible area.

55. A work-related industrial safety event that led to either of the following:

    a. Resulted in offsite medical treatment for three or more people.

    b. Had the strong potential for significant injury to a worker, such as exposure to high voltage.

### Trending events

56. Inadequate access control for any area with dose rates >10 mSv/hr (1,000 mr/hr) such that unauthorised personnel entry occurs or has the potential to occur.

57. Unplanned whole-body dose to an individual of 5 mSv (500 mrem) or greater, but less than 10 mSv (1,000 mrem) or dose to the skin or extremities that reaches or exceeds 25% of the regulatory value.

58. Insufficient control of high-risk work such as diving in the spent fuel pool, radiography or handling of highly radioactive components that contribute to actual or potential unplanned dose, overexposure or contamination events.

59. A work-related accident (not illness) that resulted in one or more of the following:

    a. offsite medical help of a worker

    b. response from offsite medical personnel

    c. a disabling injury where a lesson was learnt that could be valuable to other stations

    d. injuries that included radioactive contamination of the people involved

## Unexpected or uncontrolled release of radioactivity that exceeds onsite or offsite regulatory limits

### Significant events

60. A major release of radioactive material into the environment which exceeds limits for public dose.

**Noteworthy events**

61. A discharge or release of airborne radioactivity or radioactive liquid that exceeds onsite or offsite regulatory limits.

62. An unplanned release of radioactive material from the station that is above the regulator's defined administrative control limits.

**Trending events**

63. An unplanned release of radioactive material from the station that is above the station's defined administrative control limits.

64. An unplanned spread of radioactive contamination above the station's administrative limits outside of controlled and monitored zones (e.g. contaminated personnel released offsite, contamination or radioactive spills discovered in outside or uncontrolled areas).

MEMBERS OR REGIONAL CENTRES ARE ALSO ENCOURAGED TO REPORT RELEASES OF RADIOACTIVITY BELOW ONSITE OR OFFSITE REGULATORY LIMITS IF THE LESSONS LEARNT ARE BELIEVED TO BE OF BENEFIT TO OTHER MEMBERS.

## Fuel handling or storage events

**Significant events**

A fuel handling or storage event that involves any of the following:

65. Fuel failures or other defects that have a major operational impact on the station, such as the following:

    a. A required shutdown followed by an outage due to operational concerns or radiological impacts.

    b. Deformed or bowed fuel assemblies affect the ability to move control rods or effectively shut down the reactor.

66. Damage occurred to a nuclear fuel assembly or other core components, such as fuel, control rods or burnable poisons. This resulted in a release of radioactivity from the fuel or caused the assembly to be unusable.

67. An unplanned and/or uncontrolled loss of water from an area where fuel is required to be submerged, such as the spent fuel pool, fuel transfer canal or reactor refuelling cavity.

68. A loss of cooling for spent fuel being transferred or stored that results in or creates the potential for fuel failure. This would include fuel in transfer machines, fuel flasks and fuel storage facilities, including dry cask storage.

69. An unanticipated loss or degradation of neutron absorber that increased the effective neutron multiplication factor (k-effective).

**Noteworthy events**

70. Nuclear fuel leaks that include a unique failure mechanism or significantly impacted unit operation.

**Trending events**

71. Fuel handling/storage events that did not cause or increase the risk of significant fuel damage or radioactive release, and only impacted fuelling reliability.

72. Nuclear fuel leaks that did not significantly impact unit operation.

## Deficiencies of design, analysis, fabrication, construction, installation, operation, configuration management, man-machine interface, testing, maintenance, procedure or training

The following events will be classified according to the level of real and potential consequence.

73. Consider to report events with an INES rating level of 1 or greater.

74. Deficiencies exist in analysis, fabrication, construction, installation, transportation and shipping, operation, configuration management, man-machine interface, testing, maintenance or repair, procedures or training materials that may result in challenges to nuclear, industrial or radiological safety, reduced safety margin(s) or station reliability.

75. Events or deficiencies are noted in the quality of the station construction, operation or modification. Examples are as follows:

    a. Events[1] that could adversely affect modification quality.

    b. Use of components or material that has not received the proper quality controls during manufacture, certification or storage.

76. Events during modification which are identified and resolved. These include, but are not limited to, issues that involve installation and fabrication, qualification and training, material and equipment, personnel safety, rigging and lifting, and supply chain. Use the following guidance to determine if an item should be reported:

    a. A condition that, if it occurred or existed at another site, would be important for you to know.

    b. Condition(s) that do, or have the potential to, dramatically impact (negatively) construction quality, schedule, or personnel safety.

    c. Counterfeit[2] or fraudulent[3] items, substandard parts, or components received from suppliers.

    d. Information to help prevent construction quality, schedule, and personnel safety problems from occurring.

    e. Unique solutions developed for construction problems.

    f. Deficiencies noted that have the potential to adversely impact satisfying or maintaining inspection, test, analysis or acceptance criteria.

[1] The initiating event could be external or internal, near misses, system or component degradation, system or component failure or unavailability or findings due to any operating experience.
[2] A counterfeit item is defined as any component, part, or material that is a copy/substitute or a used original item and that is represented as new or reconditioned without the legal right or authority to do so.
[3] A fraudulent item is defined as any component, part, or material that is substandard but is intentionally misrepresented with respect to the extent it conforms to product technical/design specifications or is provided with a falsified certification.

g. A condition existed, relating to construction quality or personnel safety, for which a comprehensive root cause investigation was performed.

77. Design-related deficiencies which could lead to operational or safety margins reductions, or, even more, fuel or core failure or radioactive release:

a. Deficiencies in design hypothesis, design basis or beyond-design-basis analysis, or design management.

b. Challenge or revision of one of the design basis hypothesis (design extreme temperatures, earthquake level etc.).

c. Challenge to fundamental safety functions (reactivity, heat removal, confinement) for any reason.

d. Material or component deficiencies (including fuel) which may lead to reduced operational or safety margins.

e. Deficiencies in change process or documentation.

f. Deficiencies in spare part management or qualification.

g. Equipment failure not taken into account or new mode failure.

h. New information which challenges the adequacy of the assumptions in the design basis.

i. Deficiencies or lack in the design basis envelope or beyond-design-basis analysis that needs corrective action (containment venting, hydrogen recombiner etc.).

j. Near miss events during any mode of operation that could have challenged the operation and reduced safety margin.

k. Weaknesses in mitigating functions used in case of a beyond-design-basis event.

THIS ABOVE EVENT REPORTING CRITERION IS IRRESPECTIVE OF THE ACTUAL STATION CONSEQUENCES AND THE DISCOVERY OF DEFICIENCIES WITH THE POTENTIAL TO BE CONSEQUENTIAL SHOULD BE REPORTED.

## Other events involving station safety or reliability

**The following events will be classified according to the level of real and potential consequence.**

78. An event related to station safety or reliability, or judged by the member to be of interest to other members due to its causes or consequences.

79. A human performance event occurs that results in a challenge to nuclear safety or equipment reliability.

80. Ineffective use of OE is demonstrated by an event occurrence associated with an existing OE document, such as an SER or SOER.

81. The potential exists to impact other stations related to parts or equipment, operation, design etc.

82. A near miss event that meets the criteria for an actual event, such as personnel injury, unplanned radiation exposure and possible damage to fuel or important safety equipment.

83. A trend or summary of events that meet the 'Trend' criteria.

84. Digital control system (including human-machine interface) deficiencies that resulted in any of the following:

    a. Had an unplanned effect on any system that might affect reactivity (control rod movements and boration levels) or other critical reactor parameters (pressure, temperature, levels etc.).

    b. Caused operators to rely upon backup panels or systems because correct information was unavailable or delayed.

    c. Reduced or slowed information flow to the operators via the normal means.

    d. Provided incorrect information to the operators.

    e. System outputs affected a system other than intended.

    f. Changes made to system software other than by authorised station personnel.

    g. Saturated data buses or processors resulting in system halt or slowdown.

    h. Having wrong version of the software loaded after a system failure or hardware replacement.

85. An event that results in entry into the emergency plan or its equivalent, including deficiencies in areas such as emergency plan implementation and facility activation – this requirement pertains to problems during actual events. Problems noted during drills, training and testing do not require reporting.

    i. Problems contacting emergency response organisation personnel – this criterion does not require the reporting of instances in which individuals could not be contacted if the station was able to staff all required positions.

    j. Problems activating an emergency response facility in a timely and efficient manner.

    k. Insufficient proficiency of personnel responsible for staffing an emergency response facility.

    l. Shortfalls in risk-significant activities such as event classifications, timely notifications and protective action recommendations.

SOME OF THE ABOVE CRITERIA FOR OPERATING UNITS ARE ALSO VALID FOR UNITS UNDER CONSTRUCTION, COMMISSIONING AND DECOMMISSIONING.

**Applicable for units during construction and commissioning**

Events during construction and commissioning.

It is important to capture operating experience from units under construction and commissioning. The following are additional criteria:

86. Events that could adversely affect construction or commissioning.

87. Events that could seriously affect the project construction schedule, including rework.

88. Events that could significantly impact the overall cost of the project.

89. Material deficiencies that may be widespread among projects – including (but not limited to) counterfeit, fraudulent, or suspect items from suppliers.
90. Deficiencies that may adversely impact system or component operability.
91. Digital equipment issues or implementation deficiencies.
92. A condition that if it occurred or existed at another construction site would be important to know about.
93. Events that required a license amendment request for an event or condition that meets any of the above criteria.
94. Any condition for which a comprehensive root cause investigation was performed (root cause investigation reports).
95. Condition(s) that do, or have the potential to, dramatically impact (positively or negatively) construction quality, schedule or personnel safety.
96. Unique solutions developed for construction problems.
97. Deficiencies noted that have the potential to adversely impact satisfying or maintaining inspection, test, analysis or acceptance criteria.

**Applicable for units under decommissioning**

Some of the previous criteria are applicable for units in decommissioning. Additional criteria include:

98. Deficiencies that result in generation of large quantities of radioactive wastes.
99. Events that result in non-conforming radioactive waste.
100. Events that result in unacceptable quantities of non-radioactive pollutants and/or hazardous wastes.
101. Breach of safety barriers.
102. A condition existed, relating to construction quality or personnel safety, for which a comprehensive root cause investigation was performed.

# Manual | MN 01
# 2. Format and Content for WANO Event Reports (WERs)

Since the WANO Significant Operating Experience Reports (SOERs) and Significant Event Reports (SERs) are produced by the WANO Operating Experience staff, guidance for their format and content is not addressed here. That information is contained in the WANO Programme Guideline WPG 02, *Operating Experience*.

The responsibility for writing the WANO event reports noted below belongs to the individual WANO member; however, the WANO regional centre staff are available for guidance and assistance.

Abbreviations, initials and acronyms should be avoided. If an acronym, initial or abbreviation is included in the report, it should be clearly defined the first time it is used in a report. The preference is to physically describe the component or piece of equipment, such as auxiliary feedwater pump, not AFW pump. Additionally, components or equipment should not be identified by their identification code or component number alone. Systems should also be described to enhance another member's understanding of the event, such as reactor water clean-up, not RWCU.

When writing a WER, the consequences of the event should be clearly stated in the details section of the report, such as power was reduced by 8%, the reactor scrammed, the outage was extended by 36 hours, or the emergency diesel generator was unavailable for 24 hours. It is preferable if this information is stated in the first or second sentence.

This format and content is to be used for all WANO Event Reports (WERs).

### Preliminary WERs

Preliminary WERs should be written for events that warrant immediate notification to other WANO members or for events that **potentially meet the criteria for a noteworthy or significant classification**, as defined in this reference manual. Events that receive widespread media attention should also be reported as Preliminary WERs. This will allow members to learn of an event in a timely manner and to initiate quick investigative and/or corrective actions if necessary. Preliminary WERs are not intended to be commonly used and should not be issued for events such as reactor scrams or equipment failures with no known extenuating circumstances involved.

Examples of potential Preliminary WER events are an equipment failure that brings to light a new failure mode that is likely common to other stations, or loss of coolant accident with a potential for core damage resulting from challenges to maintaining core cooling. The potential for a similar failure may require a station to take immediate action to avoid the same event occurring at their station. Information on the causes for the event should be included, if known.

The items with a double asterisk (**), in the section list below, should be completed for all Preliminary WERs that are issued. The other items should also be completed if the information is readily available.

PUBLISHING OF A PRELIMINARY WER SHOULD NOT BE DELAYED WHILE EXACT CAUSES ARE DETERMINED.

Preliminary WERs are expected to be published in the WANO OE event reporting database within 30 days of the event discovery date. The regional centre goal is to achieve a 30-day median value. In order to meet these reporting criteria, members must report the event to their regional centre with enough margin to allow proper review before it is published. The event report is expected to be updated in the WANO OE event reporting database to include causes etc. within 140 days of the event being discovered even if the final cause analysis is not completed at that date. Once updated, the report is no longer preliminary.

A Preliminary WER should provide information on what happened during the event and what the consequences were. The report should be as concise as possible.

## WERs that were not marked as preliminary

WERs should be written for any event that meets the criterion stated in *Section 1, Criteria for Event Reporting*.

The time for publication to the WANO website, of WERs that are not marked as preliminary, is expected to be less or equal to 140 days of the event being discovered, for any event meeting the criteria for event reporting. The regional centre goal is to achieve a 140-day median value. The expectation is that all report sections are to be completed for WERs that are not marked as preliminary. If final cause analysis is completed only after 140 days the member will send an update of the WER with the final cause in attachment as soon as it is available.

All WERs, including those WERs marked as preliminary that have had the follow-up submitted, should provide a detailed description of the event and its root causes so that utilities can:

- Seek to understand the importance, consequences and lessons learned from the event.
- Determine the applicability of the event to their station designs and operating practices.
- Take actions to prevent occurrence of a similar event at their station.

A WER should briefly describe important station design features and operational practices that contributed to the event. It should also discuss the actions the utility is taking, or plans to take, to prevent recurrence. WERs should be complete, concise and easy to comprehend.

### Member information needed for a Preliminary WER or a WER not marked as preliminary

Typically, members will report events using the WANO OE event reporting database on the WANO website. However, if the WANO OE event reporting database is unavailable then event information should be provided to the member's WANO regional centre. If any questions exist, please contact your regional centre OE staff for clarification or assistance in writing the report.

## Regional Centre Review

When the station has submitted an event, regional centre OE staff will review the event to ensure that all the sections are completed as described above, all pertinent information is stated within the text sections of the event and all the appropriate codes have been applied. The regional centre staff will also ensure that the report is clear and understandable, and in particular that all the acronyms used are explained when used for the first time in the report. Once any differences are reconciled with the station, the regional centre OE staff will publish the event using the WANO OE event reporting database. When the event is

published, the WANO OE event reporting database will assign the next sequential regional centre number and the event will appear on the member website immediately.

## Performance Analysis Central Team (PACT) Activities

Once a regional centre's OE staff publishes the event, the PACT is able to add the Operating Experience Central Team (OECT) information discussed below:

- **OECT SUMMARY:** The OECT staff should write a clear, concise summary statement that includes the event description and the consequences. The text should focus on safety, reliability and provide perspective. Overall, a member should be able to determine the relevancy and applicability of the operating experience report to them, by reading the OECT summary.

- **OECT CAUSES:** Write a short description of the causes, including a description of the root cause and other important causes. Do not speculate; if the event report does not state a cause – OECT should not state one.

- **OECT QUALITY FACTORS:** Assign grading criteria on several different factors including proper use of acronyms, appropriate use of WANO coding, sufficient detail to identify the root and apparent causes, and use of clear and understandable English.

- **OECT CODING KEYWORDS:** Add keywords that relate to the event description, causes and corrective actions. The number of keywords used should be limited in number (normally five words maximum) and focused on the actual event, in order to make them more beneficial when performing analysis or event searches.

- **OECT REFERENCES:** The purpose of this section is to identify that, if Significant Operating Experience Report (SOER) and Significant Event Report (SER) recommendations and lessons learnt had been implemented, the event probably would not have occurred. Do not include SOERs and SERs just because the event involves the same type of equipment, systems, external conditions etc. The idea is to capture inadequate implementation of past published significant operating experience. The SOER format must be **SOER YYYY-XX**, where YYYY is the year the SOER was written and X is the sequential number assigned to the SOER. The SER format is similar in that it should be written SER YYYY-XX.

- **OECT SIGNIFICANCE:** Event significance is defined using four levels – Significant, Noteworthy, Trending and Other. It is based on the event type, the severity and consequences of the event, and the likelihood that the event could have been more severe (see appendix).

- **OECT APPLICABLE PERFORMANCE OBJECTIVES AND CRITERIA (PO&Cs):** The purpose of this section is to identify the PO&Cs that would be of interest for a peer review team and trending.

- **OECT REVIEWER:** Reviews the entire event report, ensuring all text and coding is correct, and then publishes the report, which now includes the data added by the OECT.

# Manual | MN 01
# 3. Practical Guide for WANO Event Report Coding System

## Purpose of the WANO Coding System

Clear and consistent reporting of the causes of events, together with the consequences, failed or affected systems/components, personnel involved, activity being performed and the unit status at the time of the event, are essential elements for the effective communication of information in a WANO event report (WER).

The coding of event reports also enhances the capability to perform searches for trends and patterns, within the WANO event population, in order to highlight generic issues and problem areas to the WANO members.

The WANO coding system was developed as a tool to facilitate greater consistency in the reporting of events and identification of problem areas within the WANO community.

## Applicability of the WANO Coding System

The codes are to be applied, by the originating WANO member, to all WERs. The codes will be made available to all WANO members as a set of 'coded fields' within each event report (see Section 5).

## The WANO Coding System Structure (11 Main Code Fields)

| | |
|---|---|
| **1. INES Level** | Select the INES level assigned to the report. If there has been no INES level assigned, select N/A or 0. |
| **2. Station Status** | The status of the reactor at the time the event occurred or was detected. |
| **3. Station Activity** | The activity that was being performed at the time the event occurred or was detected. |
| **4. Direct Cause** | The failure, action, omission or condition which immediately produced (or led to) the event. |
| **5. Category:** | Category under which the event was reported from Section 1. |
| **6. Consequence(s)*** | Consequence of the event. |
| **7. System(s)*** | Malfunctioning, failed, affected, degraded systems. |
| **8. Component(s)*** | Malfunctioning, failed, affected, degraded components. |
| **9. Group(s)*** | The staff group most involved in, or likely to learn from, the event. |
| **10. Root Cause(s)*** | The fundamental causes that, if corrected, will prevent recurrence of an unusual or adverse condition (DO NOT USE ANY CODE MARKED AS |

| | |
|---|---|
| | 'FORMER'). |
| **11. Causal Factor(s)*** | Causes that, if corrected, would not have prevented the event, but are important enough to be recognised as needing corrective action to improve the process or product (DO NOT USE ANY CODE MARKED AS 'FORMER'). |

**NOTE*:** THESE CODE FIELDS MAY CONTAIN MORE THAN ONE CODE.

## Use of the WANO Coding System

During the event investigation process and WANO event report preparation, members should seek to understand the event such that they can accurately complete the coding. Whenever possible, the investigation should be conducted in enough detail to allow as much coding as possible to be accurately completed. Thus, for an identified procedural deficiency, members should strive to explain why the procedure was deficient. For example, 'Code 0702 – Technically Incorrect', or 'Code 0703 – Technically Incomplete' should be used rather than 'Code 0700 – Written Procedures and Documents'.

Only where it has not been possible to determine the cause at a more detailed level, or when there is not an appropriate code to describe the issue accurately, should the higher level code be used.

Although event investigation methodologies may vary from member to member (e.g. HPES, ASSET, MTO, MORT, HPIP etc.) the cause descriptors (direct cause, causal factors and root causes) should be included in the report, in accordance with the definitions given in the WANO Coding System.

The WANO Coding System should not be used mechanically and in isolation from the investigation process, by taking pieces of pre-prepared report text and finding the corresponding code number.

For utilities where the WERs are prepared by a central or support organisation, experience has shown that it may be necessary to seek additional information from the station to achieve the desired level of detail needed for the event report.

# Manual | MN 01
# 4. Human Performance Problem Information

When events involve known human performance problems, that information should be included in the event description section. If unknown, then specify other:

- Type of inappropriate action (omission, too early or late, out of sequence).
- Internal (thinking) factors (misdiagnosis, confusion, unawareness, habit, wrong assumption, lack of attention).
- Type of personnel involved (operations supervisor, control room operator, station equipment operator, maintenance [mechanical, electrical, instrument/controls] supervisor, mechanical maintenance, electrical maintenance, instrument/controls technician, chemistry technician, health physics technician, engineer, contractor).
- Location (room, specific equipment area, reactor building, control room, intake structure).
- Type of activity (normal operations, abnormal/emergency operations, testing, calibration, preventive maintenance, corrective maintenance).
- Phase of physical activity (diagnosis, preparation, performing task, task completed).
- Time from inappropriate action until detection or consequences occurred.
- Method of detection (local display monitoring, remote display monitoring, observation of consequences, review of documents, supervisor review, shift/job turnover, task verification, inspection/surveillance, audit).
- Normal frequency of performing task (daily, weekly, monthly).
- Duration of task (normal time required to perform task).
- Time since this person last performed the task or received training on the task.
- Urgency of task (no immediate need to complete, some urgency, great urgency, emergency situation).

# Manual | MN 01
# 5. Operating Experience Coding System

This section lists the coding fields and options to be included in all WANO event reports.

| | |
|---|---|
| **1. INES Level** | **Section: INES Level** |
| **2. Station Status** | **Section: Reactor or Station Status** |
| **3. Station Activity** | **Section: Station Activity** |
| **4. Direct Cause** | **Section: Direct Cause Codes** |
| **5. Category** | **Section: Category** |
| **6. Consequence(s)*** | **Section: Consequences of the Event** |
| **7. System(s)*** | **Section: Systems (malfunctioning, failed, affected and degraded)** |
| **8. Component(s)*** | **Section: Components (malfunctioning, failed, affected and degraded)** |
| **9. Group(s)*** | **Section: Group(s)** |
| **10. Root Cause(s)*** | **Section: Root Cause and Causal Factor Codes** |
| **11. Causal Factor(s)*** | **Section: Root Cause and Causal Factor Codes** |

THESE CODE FIELDS MAY CONTAIN MORE THAN ONE CODE.

### International Nuclear Events Scale (INES) Level

Select the INES level assigned to the report by the regulator or by the operator. If there has been no INES level assigned, select N/A or 0.

### Reactor or Station Status

Definition: The status of the reactor at the time the event occurred or was detected.

| Code | Description of Reactor or Station Status |
|---|---|
| 025 | Construction phase of a new unit |
| 050 | Commissioning (of a new unit) |
| 110 | Steady power operation |
| 120 | Startup operations - reactor critical but < 30% power |

| Code | Description of Reactor or Station Status |
|---|---|
| 130 | Increasing power – 30% to 100% |
| 135 | Decreasing power – 100% to 0% |
| 140 | Critical at power < 2% or hot standby |
| 150 | Sub-critical coolant temperature > 93°C (it includes hot shutdown) |
| 155 | Sub-critical and coolant temperature < 93°C (it includes cold shutdown) |
| 160 | Refuelling operations or open vessel – all or some fuel inside the core |
| 165 | Refuelling operations or open vessel – fuel out of the core |
| 170* | Reduced inventory while shutdown formerly mid-loop operation |
| 180 | Not relevant |
| 190 | Decommissioning (of an existing unit) |
| 200 | Refurbishment (major upgrade/major modification) |

* Reduced inventory is defined as follows:

- **BWR:** fuel in the reactor with water level at or below the reactor vessel flange and with the reactor vessel head studs detensioned
- **PWR:** fuel in the reactor with water level at or below the reactor vessel flange
- **VVER:** fuel in the reactor with water level below the reactor vessel flange
- **LWGR (RBMK):** steam drums drained and water level maintained using temporary level instrumentation
- **PHWR:** heat transport inventory reduced to the low-level drained state
- **MAGNOX or AGR/GCR:** reactor open to air

**Station Activity**

The activity code should be used to indicate the 'activity which was being performed at the time the event occurred' or the 'activity that was being performed at the time the event was detected.'

For example, if a pipe crack occurred in a main steam line during an operating period, but there was no steam leakage and the crack was detected during a routine radiographic inspection during the station shutdown period, the **Activity Code – 65 Inspection** would be appropriate. However, if the same pipe crack had led to a steam leak on load and a subsequent reactor shut down for repair, the **Activity Code – 05 Normal Operations** would be more appropriate.

**Definition: The activity that was being performed at the time the event occurred or was detected.**

| Code | Description of Station Activity |
|---|---|
| 00 | Not relevant |
| 03 | Reactivity manipulations or reactivity management |
| 05 | Normal equipment operations |
| 06 | Equipment shutdown |
| 08 | Equipment start-up |
| 10 | Planned/preventive maintenance |
| 15 | Isolating/de-isolating |
| 20 | Repair (i.e. unplanned/breakdown maintenance) |
| 21 | Performing rework |
| 25 | Routine testing (of existing equipment) with existing procedures/documents |
| 30 | Special testing (of existing equipment) with one-off special procedure |
| 31 | Post-modification testing |
| 35 | Post-maintenance testing |
| 40 | Fault finding or troubleshooting |
| 45 | Commissioning (of new equipment) |
| 46 | New system construction (i.e. welding systems, system interconnections etc.) |
| 47 | New building construction (i.e. concrete, anchors, rebar, metal structures etc.) |
| 50 | Recommissioning (of existing equipment) |
| 55 | Decommissioning (of existing equipment) |
| 56 | Cleaning-up or disassembling a work site |
| 60 | Fuel handling/refuelling operations |
| 65 | Inspection (including in-service inspection and non-destructive testing) |
| 67 | Working at heights |
| 70 | Abnormal operation (external/internal constraints) |
| 71 | Engineering review |
| 75 | Modification implementation |
| 90 | Training |

| Code | Description of Station Activity |
|---|---|
| 95 | Actions taken under emergency conditions |
| 96 | Personnel tour/walkdowns |
| 99 | Other (please specify in text) |

## Direct Cause Codes

**Definition: The failure, action, omission or condition which immediately produced (or led to) the event.**

The direct cause codes are subdivided in nine main code groups (0100 through to 0800 and 0000) and are marked in bold. Within each main code group, there are more detailed codes to be more precise in identifying the cause. If none of these detailed codes belonging to the main code group fits your requirements, select the main group code number.

| Code | Description of Direct Cause Codes |
|---|---|
| **0100** | **MECHANICAL DEFICIENCY** |
| 0101 | Deformation, distortion, spurious movement, loosening, displacement |
| 0102 | Corrosion, erosion, fouling |
| 0103 | Overloading (including mechanical stress and overspeed) |
| 0104 | Fatigue |
| 0105 | Leak |
| 0106 | Break, rupture, crack, weld failure |
| 0107 | Blockage, restriction, obstruction, binding, foreign material, loose parts |
| 0108 | Wear, fretting, lubrication problem |
| 0109 | Vibration |
| 0199 | Other Mechanical Deficiency |
| **0200** | **ELECTRICAL DEFICIENCY** |
| 0201 | Short circuit, arcing |
| 0202 | Overheating |
| 0203 | Over voltage |
| 0204 | Under voltage, voltage breakdown |
| 0205 | Failure to change state |
| 0206 | Bad contact, disconnection |

| Code | Description of Direct Cause Codes |
|---|---|
| 0207 | Circuit failure, open circuit |
| 0208 | Ground fault |
| 0209 | Faulty insulation |
| **0300** | **CHEMICAL or CORE PHYSICS DEFICIENCY** |
| 0301 | Uncontrolled chemical reaction |
| 0302 | Core physics problems |
| 0303 | Poor chemistry or inadequate chemical control |
| 0304 | Chemical contamination, deposition |
| **0400** | **HYDRAULIC AND PNEUMATIC DEFICIENCY** |
| 0401 | Water hammer, abnormal pressure, pressure fluctuations, over pressure |
| 0402 | Loss of pressure |
| 0403 | Loss of fluid flow |
| 0404 | Cavitation |
| 0405 | Gas binding |
| 0406 | Vibration due to fluid flow |
| 0407 | Moisture in air systems |
| **0500** | **CONTROL AND INSTRUMENTATION DEFICIENCY** |
| 0501 | Oscillation |
| 0502 | False response, loss of signal, spurious signal |
| 0503 | Set point drift, parameter drift |
| 0504 | Computer hardware deficiency (including auto control loops) |
| 0505 | Computer software deficiency (including auto control loops) |
| **0600** | **ENVIRONMENTAL (ABNORMAL CONDITIONS INSIDE STATION)** |
| 0601 | Fire, burning, smoke, explosion |
| 0602 | Dropped load, high energy impacts, missiles |
| 0603 | Water ingress, flooding |
| 0604 | High temperature |
| 0605 | Radiation, contamination and irradiation of parts |

| Code | Description of Direct Cause Codes |
|---|---|
| 0606 | Pressure |
| 0607 | Humidity |
| 0608 | Low temperature (including freezing) |
| **0700** | **ENVIRONMENTAL (EXTERNAL TO THE STATION)** |
| 0701 | Lightning strikes |
| 0702 | Flooding/tsunami |
| 0703 | Wind loading/storm/tornado |
| 0704 | Earthquake |
| 0705 | Ambient temperature high |
| 0706 | Ambient temperature low (freezing) |
| 0707 | Heavy rain or snow |
| 0708 | Loss of grid, station blackout |
| 0709 | Loss of heat sink |
| 0710 | Landslide |
| 0711 | External hazards: chemical plants, boat or road traffic, air plane crash, assault etc. |
| **0800** | **HUMAN FACTORS (*see definitions below)** |
| 0801 | Slip or lapse |
| 0802 | Mistake |
| 0803 | Violation |
| 0804 | Sabotage |
| **0000** | **UNKNOWN** |
| 0001 | Unidentifiable |
| 0002 | Not yet identified |

*** Human Factors Definitions**

- Slip or lapse

  Unconscious or unintended action or inaction resulting from lack of attention or memory-based mistake during a routine activity. In spite of a good understanding of the system, process, procedure, specific context and the intention to perform the task correctly; either an unconscious, unintended action or inaction occurred, or a wrong reflex or inappropriate instinctive action took place.

- Mistake

  Intended actions resulted in undesired outcomes during a problem solving activity. The person took an incorrect action because he did not understand the system, the procedure, the specific context or the prescribed task.

- Violation

  In spite of a good understanding of the system, process, procedure and specific context, the person intentionally does not follow known rules or guidance without malevolent intention.

- Sabotage

  Intentional breaking known rules or prescribed operating guidance with malevolent intentions.

## Category

**Definition: Category under which the event was reported (to be used in conjunction with Section 1)**

| Code | Description of the Section 1 Category |
|---|---|
| 1 | Unusual station transient or events |
| 2 | Safety system malfunctions or improper operations |
| 3 | Major equipment damage |
| 4 | Excessive radiation exposure, contamination or severe personnel injury |
| 5 | Unexpected or uncontrolled release of radioactivity that exceeds onsite or offsite regulatory limits |
| 6 | Fuel handling or storage events |
| 7 | Deficiencies of design, analysis, fabrication, construction, installation, operation, configuration management, man-machine interface, testing, maintenance, procedure or training |
| 8 | Other events involving station safety or reliability |

## Consequences of the event

It is possible that a single event may have more than one consequence. For example, a feedwater pipe rupture may lead to a ‘station transient’ and ‘equipment damage’. In such cases, both consequence codes should be attributed to the event report.

| Code | Description of Consequences | Definition/Examples |
|---|---|---|
| 01 | Degraded station operating conditions | Dilution transients, breach of technical specifications.<br><br>Any situation leading to a reduced degree of safety compared to the normal station operating conditions or parameters defined in the safety analysis report, or in the technical specifications, except |

| Code | Description of Consequences | Definition/Examples |
|---|---|---|
| | | those resulting from equipment damage or from the degradation of a safety system (see below). Examples include:<br>• Abnormal level or temperature in the spent fuel pool or in the refuelling canal.<br>• Reduced shutdown margin due to uncontrolled dilution or inadequate rod position.<br>• Incorrect neutron flux distribution beyond the values taken into account for accident analysis.<br>• Nitrogen accumulation in the vessel head leading to reduced water inventory, but not affecting RHR pumps.<br>Reduced spent fuel pool integrity due to leakage or seepage of (boronated) coolant and potential corrosion of reinforced concrete. |
| 02 | Station transient | Any unplanned plant transient, such as a reactor scram or trip, significant load decrease and dramatic pressure, or temperature change that results from either a manual action or a control and protection system operation. |
| 03 | Equipment damage; fires; steam generator tube leak | Damage to major station items or safety-related equipment. For example, significant fires and steam generator tube leaks should be classified in this category. |
| 04 | Degradation of safety systems, such as reactor protection, shutdown cooling, safeguard, emergency power, ultimate heat sink, fire protection | Any event which results in reduced performance or affects the availability and redundancy of a safety system, should this system have been called upon to operate. Examples of such situations include:<br>• A shift of the actuation setpoint of a safety component (e.g. safety relief valve, safety circuit trip point for flux/temperature/pressure etc.).<br>• The demonstrated unavailability of a safety system train (e.g. failure to start of one essential diesel generator, gas turbine or diesel driven fire pump during a routine periodic test).<br>• Failure of one or more control rods to fall into the core within the specified time.<br>Within this category, all anomalies discovered during surveillance tests or preventive maintenance, which had remained undetected for a period of time, should be reported. |
| 05 | Uncontrolled release of radioactivity | Events leading to an uncontrolled or unplanned release of radioactive gas, liquid or material, in uncontrolled areas inside or outside the station that exceeds the normal background values in the area. |
| 06 | Unforeseen personnel exposure | Events leading to personnel exposure dramatically exceeding the predicted values or the authorised limits. |

| Code | Description of Consequences | Definition/Examples |
|---|---|---|
| 07 | Personal injuries | All events in which severe personnel injuries or casualties occur. |
| 08 | Degradation of a safety barrier | Safety barriers are considered to be the physical limits taken into account in the Safety Analysis Report to mitigate the consequences of severe accidents. Their integrity is normally ensured by the protection and safeguard systems. For example:<br>• fuel cladding<br>• reactor coolant system pressure boundary*<br>• containment building<br>In this context, degradation of a safety barrier is considered to be any leakage beyond that allowed in the technical specifications. For example, a steam generator tube rupture would be classified under 08.<br>* Steam generator tube leaks are classified under equipment damage 03. |
| 09 | Other | This code should be used for all events where actual consequences occurred but to which none of the other consequences codes can be attributed. (E.g. availability of the station etc.) |
| 10 | Non-consequential or near miss | Precursor occurrences having the potential for nuclear safety or station reliability consequences. This code should be used for events that did not result in any actual station consequences. |

## Systems (malfunctioning, failed, affected and degraded)

The system codes are subdivided into ten main code groups (100 through to 950) and are marked in bold. Within each main code group, there are more detailed codes to be more precise in identifying the system. If none of these detailed codes belonging to the main code group fits your requirements, select the main group code number.

| Code | Description of Systems (malfunctioning, failed, affected and degraded) |
|---|---|
| **100** | **PRIMARY REACTOR SYSTEMS** |
| 110 | Reactor core |
| 120 | Control rod (including drives and special power supply) |
| 130 | Reactor vessel and internals |
| 140 | Moderator and auxiliaries (PHWR) |
| 150 | Reactor coolant system |
| 160 | Pressure control (includes primary safety relief valves) |

| Code | Description of Systems (malfunctioning, failed, affected and degraded) |
|---|---|
| 170 | Recirculation (BWR) |
| 180 | Steam generator, boiler, steam drum |
| 190 | At power fuel handing systems (PHWR, GCR, RBMK) |
| 195 | Annulus gas systems (PHWR, RBMK) |
| **200** | **REACTOR AUXILIARY SYSTEMS** |
| 210 | Reactor core isolation cooling (BWR) |
| 215 | Auxiliary and emergency feedwater |
| 220 | Emergency poisoning function |
| 225 | Stand-by liquid control (BWR) |
| 230 | Residual heat removal |
| 235 | Chemical and volume control (PWR) |
| 240 | Emergency core cooling |
| 245 | Main steam pressure safety/relief valves (for reactors with secondary loops) |
| 255 | Core flooding accumulator (PWR) |
| 260 | Gas clean-up system (PHWR, RBMK, LMFBR) |
| 265 | Failed fuel detection |
| 266 | Reactor emergency depressurisation |
| **300** | **ESSENTIAL AUXILIARY SYSTEMS** |
| 310 | Component cooling water |
| 315 | Essential raw cooling or service water |
| 316 | Essential auxiliary steam (GCR) |
| 317 | $CO_2$ injection and storage (GCR) |
| 320 | Essential compressed air |
| 325 | Borated or refuelling water storage |
| 330 | Condensate storage |
| 335 | Spent fuel pool or refuelling pool cooling and clean-up |
| 340 | Containment isolation |

| Code | Description of Systems (malfunctioning, failed, affected and degraded) |
|---|---|
| 345 | Main steam/feedwater isolation function |
| 350 | Containment spray and ice condenser |
| 355 | Containment pressure suppression (not including spray) |
| 360 | Containment combustible gas control |
| 361 | Nitrogen supply and storage |
| **400** | **ELECTRICAL SYSTEMS** |
| 410 | High voltage AC (greater than 15kV including offsite power) |
| 420 | Medium voltage AC (600V to 15kV) |
| 430 | Low voltage AC (less than 600V, mainly 480V) |
| 440 | AC & DC supplies to vital instrumentation, control and computers |
| 445 | DC power supplies |
| 450 | Emergency power generation and auxiliaries |
| 460 | Security and access control |
| 470 | Communication and alarm annunciation |
| 480 | UPS (Uninterruptible power supply system) |
| **500** | **FEEDWATER, STEAM , CONDENSATE AND POWER CONVERSION SYSTEMS** |
| 510 | Main steam and auxiliaries (including auxiliary steam) |
| 520 | Turbo-generator and auxiliaries |
| 530 | Main condenser and auxiliaries (including off gas systems) |
| 540 | Turbine by-pass |
| 550 | Condensate and feedwater |
| 560 | Condensate demineraliser |
| 570 | Circulating water or condenser cooling water (including raw & service water cooling) |
| **600** | **HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS** |
| 605 | Cooling system for control rod drive mechanism (air or water) |
| 610 | Primary reactor containment building HVAC ventilation |
| 615 | Primary containment vacuum and pressure relief |

| Code | Description of Systems (malfunctioning, failed, affected and degraded) |
|---|---|
| 620 | Secondary containment recirculation, exhaust and gas treatment |
| 625 | Dry well or wet well ventilation, purge and inerted |
| 630 | Nuclear or reactor auxiliary building ventilation |
| 635 | Control building ventilation, main control room ventilation |
| 640 | Fuel building ventilation |
| 645 | Turbine building ventilation |
| 650 | Emergency generator building ventilation |
| 660 | Miscellaneous structures ventilation |
| 665 | Chilled water |
| 670 | Station stack |
| 675 | Seismic/bunkered emergency control building ventilation |
| **700** | **INSTRUMENTATION AND CONTROL SYSTEMS** |
| 710 | Station/process computer (including main and auxiliary computers) |
| 715 | Fire detection |
| 720 | Environment monitoring |
| 725 | Turbo-generator instrumentation and control |
| 730 | Station monitoring (including main control room equipment & remote control functions) |
| 735 | In-core and ex-core neutron monitoring |
| 740 | Leak monitoring |
| 745 | Radiation monitoring (in the station and of workers) |
| 750 | Reactor power control |
| 751 | Reactor protection |
| 755 | Recirculating flow control (BWR) |
| 756 | Pressure control |
| 760 | Feedwater control |
| 765 | Engineered safety features actuation (including emergency systems actuation) |
| 770 | Non-nuclear instrumentation |

| Code | Description of Systems (malfunctioning, failed, affected and degraded) |
|---|---|
| **800** | **SERVICE AUXILIARY SYSTEMS** |
| 810 | Sampling |
| 820 | Control and service air (non-essential), compressed gas |
| 830 | Demineralised water |
| 840 | Material and equipment handling (including cranes, tools & lifting devices) |
| 850 | Nuclear fuel handling and storage, fuel route |
| 860 | Fire protection |
| 870 | Chemical additive injection and make-up |
| 880 | Sodium heating systems (FBR) |
| 890 | Air-breath supply system (air supply to protective suits) |
| **900** | **STRUCTURAL SYSTEMS** |
| 910 | Primary reactor containment building |
| 915 | Secondary reactor containment building or vacuum building (PHWR) |
| 920 | Reactor or nuclear auxiliary building |
| 922 | Control building |
| 925 | Emergency generator building |
| 928 | Fuel building (including wet and dry storage buildings) |
| 930 | Turbine building |
| 932 | Waste management building |
| 935 | Pumping stations |
| 938 | Back-up ultimate heat sink building |
| 940 | Cooling towers |
| 945 | Switchyard (open/enclosed) |
| 946 | Seismic/bunkered emergency control building |
| 947 | Seismic instrumentation |
| **950** | **WASTE MANAGEMENT SYSTEMS** |
| 952 | Laundry |

| Code | Description of Systems (malfunctioning, failed, affected and degraded) |
|---|---|
| 955 | Liquid radwaste |
| 960 | Solid radwaste |
| 962 | Gaseous radwaste |
| 965 | Non-radioactive waste (liquid, solid and gaseous) |
| 968 | Steam generator blowdown (secondary side) |
| 970 | Station drainage (floor, roof etc.) |
| 972 | Equipment drainage (including vents) |
| 973 | Site ground water |
| 975 | Suppression pool clean-up (BWR) |
| 980 | Reactor water clean-up (BWR) |
| 999 | Other |
| 000 | NONE of the above systems or unidentified |

## Components (malfunctioning, failed, affected, degraded)

Component codes are subdivided into eight main code groups (100 through to 800 and code 000) and are marked in bold. Within each main code group, there are more detailed codes to be more precise in identifying the component. If none of these detailed codes belonging to a main code group fits your requirements, select the main group code number.

| Code | Description of Components (malfunctioning, failed, affected, degraded) |
|---|---|
| **100** | **INSTRUMENTATION** |
| 110 | Neutron flux (detectors, ion chambers, associated components) |
| 120 | Pressure |
| 121 | Temperature |
| 122 | Level |
| 123 | Flow |
| 124 | Speed measurement |
| 130 | Radiation/contamination |
| 140 | Concentration |
| 150 | Position |

| Code | Description of Components (malfunctioning, failed, affected, degraded) |
|---|---|
| 160 | Dew point, moisture |
| 170 | Fire detectors |
| 180 | Hydrogen detectors |
| 190 | Electrical (current, voltage, power etc.) |
| **200** | **MECHANICAL** |
| 210 | Pumps, compressors, fans |
| 220 | Turbines (steam, gas, hydro), engines (diesel, petrol etc.) |
| 230 | Valves (including safety, check, relief & solenoid), valve operators, controllers, dampers (including fire dampers), seals and packing, flanges, orifices, drain traps, diaphragm rupture disks |
| 240 | Heat exchangers (heaters, coolers, condensers, boilers), heat exchanger tube plugs |
| 250 | Tanks, pressure vessels, accumulators (e.g. reactor vessel and internals, accumulators) |
| 260 | Tubes, pipes, ducts |
| 270 | Fittings, couplings (including transmissions and gearboxes), hangers, supports, bearings, snubbers |
| 280 | Strainers, screens, filters, ion exchange columns |
| 290 | Penetrations/doors (personnel and equipment access, fuel handling) |
| 295 | Fuel storage racks, fuel storage casks and fuel transport containers |
| **400** | **ELECTRICAL** |
| 410 | Switchyard equipment (switchgear, transformers, buses, reactors, arresters, line isolators) |
| 420 | Circuit breakers, power breakers, fuses |
| 425 | Batteries |
| 430 | Motors (for pumps, fans, compressors, motor generators) |
| 440 | Generators of emergency and standby power |
| 450 | Main generator and auxiliaries |
| 460 | Relays, connectors, hand switches, push buttons, contacts |
| 470 | Wiring, logic circuitry, controllers, starters, cables, transmitters, switches |
| 480 | Alarms |
| 490 | Electronic cards |

| Code | Description of Components (malfunctioning, failed, affected, degraded) |
|---|---|
| **500** | **LIFTING DEVICES** |
| 510 | Polar crane |
| 520 | Gantry crane |
| 530 | All self-propulsion cranes |
| **600** | **NUCLEAR ASSEMBLIES** |
| 610 | Absorber assemblies |
| 620 | Fuel assemblies (block type, cluster type and spherical fuel elements are included) |
| 630 | Breeder assemblies |
| 640 | Flow restrictor (assemblies) |
| 650 | Burnable absorber assemblies |
| 660 | Reflector assemblies |
| 665 | Moderator assemblies |
| 670 | Neutron sources |
| 680 | Shielding equipment |
| 685 | Special assemblies |
| 690 | Control rods |
| **700** | **COMPUTERS** |
| 710 | Computer hardware |
| 720 | Computer software |
| **800** | **CIVIL** |
| 810 | Concrete (Including material properties) |
| 820 | Rebar, reinforcement, steel work |
| 830 | Steel liners |
| 840 | Pre-/post-stressing cables (including associated instrumentation and equipment) |
| 850 | Welds (related to civil structures) |
| 860 | Coatings, paints etc. |
| 870 | Building penetrations, sealants (including gaskets etc.) |

| Code | Description of Components (malfunctioning, failed, affected, degraded) |
|---|---|
| **000** | **UNIDENTIFIED or no specific component involved**<br><br>**(This code to be used where inappropriate human action is the direct cause of the event).** |

## Group(s)

**Definition:** The group of staff most involved in or likely to learn from the event.

The group codes are subdivided into four main code groups (0100 through to 0400) and are marked in bold. Within each main code group, there are more detailed codes to be more precise in identifying the group. If none of these detailed codes belonging to the main code group fits your requirements, select the main group code number.

| Code | Description of Group |
|---|---|
| **100** | **MAINTENANCE general** |
| 110 | Shift |
| 120 | Electrical |
| 130 | Instrument |
| 140 | Mechanical |
| 150 | Fuel route (maintenance activities) |
| 160 | Civil |
| 170 | Work planning or scheduling |
| **200** | **OPERATIONS general** |
| 210 | Shift – control room operators |
| 220 | Shift – field operators |
| 230 | Day |
| 240 | Fuel route (operation activities) |
| **300** | **TECHNICAL AND ENGINEERING general** |
| 301 | System engineering |
| 302 | Project engineering |
| 310 | Chemistry |
| 320 | Station performance |
| 330 | Reactor physics |

| Code | Description of Group |
|---|---|
| 340 | Mechanical |
| 350 | Instrument |
| 360 | Electrical |
| 370 | Health physics |
| 380 | Emergency planning |
| 390 | Industrial safety |
| **400** | **MANAGEMENT AND ADMINISTRATION general** |
| 410 | Planning |
| 420 | Contractors |
| 430 | QA |
| 440 | Training |
| 450 | Document production |
| 460 | Security |
| 470 | Procurement |
| 480 | Stores |
| 490 | All management groups |

## Causes and Causal Factor Codes

**Definitions:**

**ROOT CAUSE:** The fundamental cause(s) that, if corrected, will prevent recurrence of an unusual event or adverse condition. If a root cause is not definitively determined, enter the most likely or apparent root cause(s) from the list of root causes provided in the WANO OE event reporting database.

**CAUSAL FACTOR:** Cause(s) that, if corrected, would not alone have prevented the event, but are important enough to be recognised as needing corrective action to improve the quality of the process or the product.

For the definition of the root cause and causal factor codes, there are differing approaches used throughout the WANO member organisations. The originator should use the definitions of root cause and causal factor given in the WANO Code List when completing their event reports, to ensure consistency of approach.

For each event, at least one root cause should be attributed. Where it has been possible to determine more than one root cause, or more than one causal factor, no ranking should be made as to which is the most important. The root cause codes applied to the event should be consistent with the text of the report.

The root cause and causal factor codes are subdivided in 22 main code groups (0100-1099, 1100-1800, 2000-2300) marked in bold. Within each main code group, there are more detailed codes to be more precise in identifying the root cause and causal factor. If none of these codes belonging to the main code group fits your requirements, select the main group code number.

Codes with the word 'Former' preceding the name should not be used. It was a code used in the old database but should no longer be used.

Code to be used ONLY when no other code is available:

Code Limited use code for root cause and causal factors

0014 Unknown

**Human Performance (HU) Related (Codes 0100 through to 1099)**

| **Code** | **Description of HU Related Root Cause and Causal Factor Codes** |
|---|---|
| **0100** | **VERBAL COMMUNICATIONS** |
| 0101 | Shift handover inadequate |
| 0102 | Pre-job briefing inadequate/not performed |
| 0103 | Message misunderstood/misinterpreted |
| 0104 | Communications equipment inadequate or not available |
| 0105 | Receiver not listening |
| 0106 | Communications incorrect/inadequate |
| 0107 | Internal team communication inadequate |
| 0108 | Inter-team communication inadequate |
| 0109 | Supervisor not notified of problem |

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| **0200** | **PERSONNEL WORK PRACTICES** |
| 0201 | Self-checking not used or ineffectively applied |
| 0202 | System alignment/isolation not verified |
| 0203 | Required procedures, drawings or other references not used |
| 0204 | Administrative controls circumvented or intentionally not performed |
| 0205 | Conditions not verified prior to work |
| 0206 | Task not adequately researched prior to start |
| 0207 | Unauthorised material substitution |
| 0208 | Inadvertent bumping, stepping on or damage to equipment |
| 0209 | Radiological/ALARA work practices not followed |
| 0210 | Inattention to detail |
| 0211 | Independent checking not used or ineffectively applied |
| 0212 | Unsafe working practices applied |
| 0213 | Personal protective equipment not used/worn |
| 0214 | Improper tools/equipment used |
| 0215 | Failure to maintain written logs |
| 0216 | Inappropriate habits developed through group pressure/culture |
| 0217 | Lack of questioning attitude |
| 0218 | Violation of policies/rules/procedures |
| **0300** | **PERSONNEL WORK SCHEDULING** |
| 0301 | Excessive overtime |
| 0302 | Called in during unsociable hours |
| 0303 | Working continuously for considerable number of hours |
| 0304 | Working without rest day for considerable time |
| 0305 | Frequent changes of shift |
| 0306 | Time pressure to complete task |
| 0307 | Unfamiliar work cycle |

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| **0400** | **ENVIRONMENTAL CONDITIONS** |
| 0401 | Lighting inadequate |
| 0402 | Housekeeping inadequate |
| 0403 | Temperature too hot/cold |
| 0404 | Excessive noise level |
| 0405 | High humidity |
| 0406 | High radiation |
| 0407 | Cramped work space |
| 0408 | Distractions |
| **0500** | **MAN-MACHINE INTERFACE** |
| 0501 | Label missing/inadequate |
| 0502 | Interface design inappropriate for task |
| 0503 | Controls provided not adequate |
| 0504 | Alarms provided not adequate |
| 0505 | Alarm masking/cancelling |
| 0506 | Too many standing alarms |
| 0507 | Too many incoming alarms |
| 0508 | Indications provided not adequate |
| 0509 | Inadequate signage or barriers |
| **0600** | **TRAINING/QUALIFICATION** |
| 0601 | Training not provided on how to perform a task |
| 0602 | Training not provided on how to use special equipment or tools |
| 0603 | Training not provided on relevant system(s)/components |
| 0604 | Training not based on current station requirements |
| 0605 | Demonstration of task proficiency not required prior to qualification |
| 0606 | Insufficient refresher training |
| 0607 | Training not attended |
| 0608 | Training standard not adequate |

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| 0609 | Training not provided to required level of competence for task |
| 0610 | Training not provided in personnel work practice |
| 0611 | Shortfall in on-job training/experience |
| 0612 | Inadequate definition of required qualifications |
| **0700** | **WRITTEN PROCEDURES AND DOCUMENTS** |
| 0701 | No document available |
| 0702 | Technically incorrect |
| 0703 | Technically incomplete |
| 0704 | Cautionary information not included |
| 0705 | Not up to date with station design |
| 0706 | Not formally stated |
| 0707 | Unclear or complex wording |
| 0708 | Format deficiencies |
| 0709 | User aids deficient/not provided |
| 0710 | Inadequate technical review process |
| 0711 | Responsibility for following procedure not stated |
| 0712 | Inadequate safety assessment provided |
| **0800** | **SUPERVISORY METHODS** |
| 0801 | Duties and tasks not clearly explained |
| 0802 | Progress not adequately monitored |
| 0803 | Supervision levels not decided prior to task |
| 0804 | Supervisor too involved in tasks |
| 0805 | Inappropriate balance between timescale and standards |
| 0806 | Standards not adequately communicated |
| 0807 | Control of contractors inadequate |
| 0808 | Frequent task re-allocation |
| 0809 | Inappropriate selection of staff for task |
| 0810 | Safety aspects of task not emphasised |

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| **0900** | **WORK ORGANISATION** |
| 0901 | Planning done without site visit |
| 0902 | Special conditions or requirements not identified |
| 0903 | Co-ordination of all relevant on-site departments not achieved |
| 0904 | Work initiated prior to ensuring all skills, parts, tools, instruments etc., are available |
| 0905 | Job walk through not performed |
| 0906 | Work package did not address all administrative requirements |
| 0907 | Scheduling conflicts not identified |
| 0908 | Task or routine not assigned |
| 0909 | Too few workers allocated to task |
| 0910 | Too few workers of the correct trade/specialisation |
| 0911 | Co-ordination of relevant onsite and offsite departments not achieved |
| 0912 | Planning of parallel tasks inadequate |
| **1000** | **PERSONAL FACTORS** |
| 1001 | Fatigue |
| 1002 | Stress/perceived lack of time/boredom |
| 1003 | Skill of the craft less than adequate/not familiar with job performance standards |

**Management-Related (Codes 1100 through to 1999)**

| Code | Description of Management Related Root Cause and Causal Factor Codes |
|---|---|
| **1100** | **MANAGEMENT DIRECTION** |
| 1110 | Policies, official guidance (standards), expectations, administrative controls: not developed |
| 1120 | Policies, official guidance (standards), expectations, administrative controls: not enforced |
| 1130 | Policies, official guidance (standards), expectations, administrative controls: not adequate (not strict enough, confusing or incomplete) |
| **1200** | **COMMUNICATION OR CO-ORDINATION** |
| 1210 | Policies, official guidance (standards), expectations, administrative controls: not communicated effectively within the organisation |
| 1220 | Familiarity of workers with relevant policies and/or official guidance not verified |

| Code | Description of Management Related Root Cause and Causal Factor Codes |
|---|---|
| 1230 | Inadequate coordination/communication between departments |
| 1240 | Coordination/communication not sufficiently promoted by management |
| 1250 | Inadequate communication between management and station staff, inadequate feedback from station staff to management, employee concerns fail to reach management attention |
| 1260 | No prompt responses to employee concerns |
| **1300** | **MANAGEMENT MONITORING AND ASSESSMENT** |
| 1310 | Inadequate level of management involvement |
| 1320 | Inadequate establishment/support of programmes or processes |
| 1330 | Inadequate monitoring of the effectiveness of programmes or processes |
| 1340 | Inadequate monitoring of results of decisions/assignments |
| 1350 | Inadequate assessment of the effectiveness of corrective actions |
| 1360 | Inadequate assessment of personnel behaviour and performance |
| 1370 | Information or monitoring system does not give accurate and in-time information |
| **1400** | **DECISION PROCESS** |
| 1410 | Officially designated responsibilities and accountabilities unclear |
| 1420 | Decision process too lengthy/time consuming |
| 1430 | Decisions based on insufficient information |
| 1440 | Risks and consequences of decision not identified or assessed before decision made |
| 1450 | Management objectives did not encompass known problems |
| 1460 | Management objective did not reflect a relevant constraint |
| 1470 | Inadequate operating experience feedback process (corrective actions not defined, inadequate or not implemented promptly, root causes of known problems not addressed) |
| 1480 | Improvement campaigns ineffective |
| 1490 | Operational decision is not adequate |
| **1500** | **ALLOCATION OF RESOURCES** |
| 1510 | Insufficient resources allocated for identified objectives (includes resources such as training, supervision, documentation, tools, materials and equipment) |
| **1600** | **CHANGE MANAGEMENT** |
| 1610 | Need for change, further change not identified |

| Code | Description of Management Related Root Cause and Causal Factor Codes |
|---|---|
| 1620 | Change not implemented in adequate timescale |
| 1630 | Inadequate resourcing of change |
| 1640 | Consequences of change not adequately assessed |
| 1650 | Change-related training/briefing inadequate |
| 1660 | Change-related documentation alteration inadequate |
| 1670 | Change-related equipment provision inadequate |
| 1680 | Results of change not monitored for correctness |
| 1690 | Changes to plant equipment, procedures and processes not systematically planned and implemented |
| 1691 | Change objectives, responsibilities and implementation schedules are not clearly communicated |
| **1700** | **ORGANISATIONAL/SAFETY CULTURE** |
| 1710 | Punitive responses to genuine slips or mistakes |
| 1720 | Lack of blame-free reporting culture |
| 1721 | Safety concerns are not promptly addressed |
| 1730 | Staff do not have "do it right the first time" attitude |
| 1740 | Taking of short-cuts allowed/tolerated |
| 1750 | Low morale among station staff |
| 1760 | Recurrent violation of rules |
| 1770 | General lack of questioning attitude, weaknesses exist in identifying or raising concerns related to nuclear safety |
| 1780 | Lack of conservative approach in control room |
| 1790 | Lack of teamwork in control room |
| 1791 | Weakness in or lack of defence-in-depth and risk management practices related to plant safety, reliability or mitigation of events, including severe accidents |
| 1792 | Lack or weaknesses in raising nuclear safety concerns |
| **1800** | **MANAGEMENT OF CONTINGENCIES** |
| 1810 | Organisation unprepared to handle unforeseen events |
| 1820 | No management oversight of problem-solving by workers for unforeseen events |

| Code | Description of Management Related Root Cause and Causal Factor Codes |
|---|---|
| 1830 | Weaknesses in emergency preparedness |
| 1840 | Weaknesses in contingency planning |

**Equipment-Related (Codes 2000 through to 2399)**

| Code | Description of Equipment Related Root Cause and Causal Factor Codes |
|---|---|
| **2000** | **DESIGN CONFIGURATION AND ANALYSIS** |
| 2001 | Original design inadequate |
| 2002 | Design documentation/prints inadequate |
| 2003 | Design analysis deficiency |
| 2004 | Component selection inadequate |
| 2005 | Material selection inadequate |
| 2006 | Unauthorised or unreviewed modification |
| 2007 | Inadequate review of design changes |
| 2008 | Field walk through input to design inadequate |
| 2009 | Historical design does not meet current requirements (e.g. changes in external or internal hazards for example) |
| 2010 | Inappropriate reliance on human action |
| 2011 | Deficiency in engineering of modification, including follow-up of implementation |
| 2012 | Inadequate risk analysis performed, including design or modification risk assessment and maintenance vulnerability |
| 2013 | Failure mode or risk or consequences of a failure is not adequately taken into account |
| 2014 | Common cause failure vulnerability is not adequately considered or analysed |
| 2015 | Safety function redundancy or diversification is insufficient, including cable or function separation |
| **2100** | **EQUIPMENT SPECIFICATION, MANUFACTURE, TRANSPORTATION, INSTALLATION AND CONSTRUCTION** |
| 2101 | Material used inadequate |
| 2102 | Manufacturer fabrication/construction inadequate |
| 2103 | Specifications provided to manufacturer inadequate |

| Code | Description of Equipment Related Root Cause and Causal Factor Codes |
|---|---|
| 2104 | Substitute parts/material used during installation (except code 2110) |
| 2105 | Lack of proper tools/materials used do not meet specifications |
| 2106 | Installation workmanship inadequate |
| 2107 | QA requirements not used or met during procurement process |
| 2108 | Equipment installed does not meet all codes/requirements (except code 2110) |
| 2109 | Post procurement requirements not used/performed |
| 2110 | Counterfeit item/fraudulent item |
| 2111 | Packaging deficiencies and transport damage. |
| **2200** | **MAINTENANCE/TESTING/SURVEILLANCES** |
| 2201 | Corrective maintenance did not correct problems |
| 2202 | Other problems noted during the performance of maintenance/testing not corrected |
| 2203 | Preventive maintenance inadequate |
| 2204 | Maintenance performed incorrectly |
| 2205 | Testing not performed as required, Inadequate testing and maintenance programme |
| 2206 | Post-maintenance testing inadequate |
| 2207 | Post-modification testing inadequate |
| 2208 | Retest requirements not specified |
| 2209 | Retest delayed |
| 2210 | Test acceptance criteria inadequate |
| 2211 | Test results review inadequate |
| 2212 | Surveillance schedule not followed |
| 2213 | Situational surveillance not performed |
| 2214 | Required surveillance/test not scheduled |
| 2215 | Equipment outside acceptance criteria |
| 2216 | Incorrect parts/consumables installed/used |
| 2217 | Failure to exclude foreign material |
| 2218 | Incorrect restoration of station following maintenance/isolation/testing |

| Code | Description of Equipment Related Root Cause and Causal Factor Codes |
|---|---|
| 2219 | Parts received from vendor/supplier/manufacturer for which the acceptance testing by the vendor/supplier/manufacturer was falsified |
| **2300** | **EQUIPMENT PERFORMANCE** |
| 2301 | Equipment operated outside of design specifications |
| 2302 | Ageing of component |
| 2303 | Known problems not corrected, including deficiencies in reporting findings |
| 2304 | Degraded sub-component contributed to failure |
| 2305 | Component monitoring or parameter trending inadequate |
| 2306 | Component beyond expected lifetime |
| 2307 | Externally damaging condition not properly evaluated or correlated |
| 2308 | Equipment erosion/corrosion |
| 2309 | Failed within expected lifetime |

## Key Words

The keyword list will be maintained by the WANO Performance Analysis Central Team (PACT). Changes must be discussed with OE database information manager and will be approved by the Performance Analysis programme director.

Every WER with published significance have at least one keyword (‘1 – for information only’, or ‘2 – important lessons’). Events coded with ‘2 - important lessons’ are events that PACT considers containing important lessons learnt. If keyword 2 was assigned to the WER, PACT thinks that members should pay particular attention to the report.

Definition of keywords ‘2 – important lessons’ and ‘1 – for information’ only are:

- 2 – important lessons: WER which describes an event of particular industry interest or contains important lessons learnt that can potentially help members to select those learnings, regardless of the event significance. The application of keyword 2 to a WER is based on common PACT agreement.

- 1 – for information only: Every WER without keyword ‘2 – important lessons’.

## Peer Review Objectives and Criteria (PO&C)

The PO&C code list will correspond to the WANO PO&Cs.

# Manual | MN 01
# Attachment 1 – WANO Event Report Template

| **Note: As a minimum these items should be completed for all Preliminary WERs | |
|---|---|
| **Report Section** | **Information Provided by the Station** |
| **Station:** | State the common name of the station |
| **Event Date:** | Enter the date the event was discovered or occurred; dd/mm/yyyy |
| **Title:** | Tick the 'Preliminary' box. The title should include the most important aspect(s) of the event. For the same event, the follow-up WER should have the same title as the Preliminary WER. |
| **Reference Unit:** | Select the unit on which the event occurred (one unit only) |
| **Station Event:** | State if this is a station[4] event or a unit event |
| **Summary:** | Provide a brief summary of the event, or condition being reported, to provide the reader with information of interest. Describe the event in the proper perspective, the consequences and the direct cause in a concise way. Overall, the reader should be able to determine the relevancy and applicability of the operating experience report by reading the summary. |
| **Event units:** | List all of the units affected by the event. |
| **References:** | Reference other documents, such as technical reports, for information related to the event or similar events. List all other reports or documents associated with this event. |

[4] A station can consist more than one unit.

| **Note: As a minimum these items should be completed for all Preliminary WERs | |
|---|---|
| **Report Section** | **Information Provided by the Station** |
| **Report Description:** | Preliminary WER:<br><br>Include a short description of the event, including items such as equipment action or failures, changes to station operating conditions or consequences and personnel actions. If known, causes, equipment malfunctions, manufacturer and model number should be included.<br><br>WER:<br><br>Include a detailed description of the event, including the following when applicable:<br><br>State the plant[5] status before and after the event.<br><br>List the sequence of actions that occurred during the event and actions that occurred before the event, if they are applicable. Attach an action sequence list (chronology) or chart, if needed, to better understand the event.<br><br>State changes to operating conditions during the event. |
| **Report Description** | List components/systems (including manufacturer name and model number) that malfunctioned. Also, include personnel errors that occurred during the event (Section 4 lists human performance problem information that also should be considered when a personnel error occurred).<br><br>State the design/beyond design weaknesses identified and the proposed short-term and long-term corrective actions.<br><br>Note:<br><br>The primary focus of the report is to share causes and lessons learned. |
| **Revision:** | Revision of the WER document |

[5] The term plant is used for identifying the station as well as for a specific unit in the station. A station can have several units.

| **Note: As a minimum these items should be completed for all Preliminary WERs | |
|---|---|
| **Report Section** | **Information Provided by the Station** |
| **Consequences:** | Include a description of event consequences or potential consequences, such as injured personnel, damaged equipment, radioactive discharge or operational limits exceeded. The consequences should be clearly stated in the first or second sentence of the event description.<br><br>If it is a unit event, this section should include what occurred to the unit, such as a reactor scram, turbine trip, reactor power decrease by 10% or more, substantial turbine power decrease or loss of one of three safety trains.<br><br>If the event resulted or occurred in an outage, indicate the duration of the outage or extension.<br><br>If there is a design or beyond-design-basis mitigation deficiency, this section should include its impact on nuclear safety in terms of consequences or potential consequences. |
| **Report Analysis and Comments:** | Include a discussion of the importance of the event, including the root causes and apparent causes, and any additional causal factors and lessons learned. Causes should include reasons for equipment malfunctions, human performance errors (including man-machine interface), design deficiencies, manufacturing or construction deficiencies and external causes.<br><br>Note:<br><br>It is important that, in the analysis and comments section, the causes of the event be clearly identified and discussed, since only removal of these causes can prevent a recurrence of the event. Most events have several causes; therefore, this section should go beyond just the direct or obvious reasons why an event occurred, to address additional underlying event cause(s). For recurring events, the reasons for the event's recurrence should be noted, if known. |
| **Corrective Actions:** | Preliminary WER:<br><br>Include a description of any immediate corrective actions taken as well as planned corrective actions, at the time the event is reported.<br><br>Note:<br><br>The event may be issued as a Preliminary WER without this information.<br><br>WER:<br><br>Include a description of the corrective actions taken or planned by the member to prevent an event recurrence, such as procedure changes, personnel training or design modifications. The corrective actions should address the causes of the event, as identified in the analysis and comments section of the report including how they will reinforce nuclear safety. |
| **Note:** | It is requested that all code fields below be completed. |
| ***Note:** | *These code fields may contain more than one code. |

| **Note: As a minimum these items should be completed for all Preliminary WERs | |
|---|---|
| **Report Section** | **Information Provided by the Station** |
| **INES Level:** | Select the INES level assigned to the report. If there has been no INES level assigned, select 0. |
| **Station Status:** | State the status of the reactor or station at the time the event occurred or was detected (use one code from Section 5.2 Reactor or Station Status). |
| **Station Activity:** | State the activity that was being performed at the time the event occurred or was detected (use one code from Section 5.3 Station Activity). |
| **Direct cause:** | State the failure, action, omission or condition which immediately produced (or led to) the event (use one code from Section 5.4 Direct Cause Codes). |
| **Category:** | Determine a category under which the event was reported from Section 1 of this document (use one code from Section 5.5 Category). |
| ***Consequence(s):** | State the consequence of the event (use as many codes as necessary from Section 5.6 Consequences of the Event). |
| ***System(s):** | State malfunctioned, failed, affected or degraded systems (use as many codes as necessary from Section 5.7 Systems [malfunctioning, failed, affected and degraded]). |
| ***Component(s):** | State malfunctioned, failed, affected or degraded components (use as many codes as necessary from Section 5.8 Components [malfunctioning, failed, affected and degraded]). |
| ***Group(s):** | The staff group most involved in or likely to learn from, the event (use as many codes as necessary from Section 5.9 Group(s)). |
| ***Root cause(s):** | The fundamental causes that, if corrected, will prevent recurrence of an unusual or adverse condition (use as many codes as necessary from Section 5.10 Root Cause and Causal Factor Codes). |
| ***Causal factor(s):** | List causes that, if corrected, would not alone have prevented the event, but are important enough to be recognised as needing corrective action (use as many codes as necessary from Section 5.10 Root Cause and Causal Factor Codes). |
| **List Attachments:** | Preliminary WER:<br><br>Include any attachments that are available at the time the Preliminary WER is issued.<br><br>WER:<br><br>Include any attachments, such as a list of the sequence of actions that occurred during the event, tables of data, photographs or system drawings, which can improve the understanding of the event. The attachments should be provided with the report to the applicable regional centre, for posting on the member website. |

| **Note: As a minimum these items should be completed for all Preliminary WERs | |
|---|---|
| **Report Section** | **Information Provided by the Station** |
| ****Confidentiality Notice and Liability Disclaimer Notice** | A confidentiality notice and liability disclaimer notice shall be included in each WANO event report, in accordance with WANO Policy Document 4, *Confidentiality*. The WANO OE event reporting database will automatically add this disclaimer notice, where appropriate. |

# Manual | MN 01
# Attachment 2 – Practical Guide on the use of WANO Coding System

The following event report is fictional, but loosely based on several events reported to WANO in the past. Its purpose is as an example of how to use the WER template and apply the WANO codes to a typical WER.

| | | |
|---|---|---|
| **** Note** | ****As a minimum these items should be completed for all Preliminary WERs** | |
| **** Station** | Wild Horses Unit 2 | |
| **** Event Date** | 03 March 2011 | |
| ****Title** | Main Transformer Fire | |
| ****Reference Unit** | Wild Horses 2 | |
| ****Station Event** | Unit event | |
| **Summary** | On 03 March 2011, while Wild Horses Nuclear Station Unit 2 was operating at 100% steady state power, the main power transformer experienced a phase-to-phase internal fault. This resulted in a main generator trip, a unit scram and a fire inside the transformer that ruptured and destroyed the transformer. The fire brigade and the transformer automatic fire suppression system acted to extinguish the fire within 10 minutes. All station systems functioned as expected and the station was stabilised and was taken to cold shutdown. No personnel injuries occurred and no station equipment, other than the transformer, was damaged. | **Reactor or Station Status – 110 – Steady power operation** – prior to the event the reactor was operating at a steady 100% power<br><br>**Station Activity – 05 – Normal equipment operation** – the event occurred during normal power operation, nothing out of normal was on-going |
| **Event units** | No others | |
| **References** | WANO<br><br>115. WER PAR 11-020 *Transformer Failure*<br>116. WER TYO 10-033 *Transformer Fire* | |
| **Report Description** | On 03 March 2011, the main power transformer faulted causing a fire, damage to the transformer and an automatic scram of the unit. Site personnel and the transformer's automatic fire-suppression system extinguished the fire. All station systems functioned as expected, the station is stable and is in cold shutdown. No personnel injuries occurred and no station equipment, other than the transformer, were damaged. | **Category – 3 – Major equipment damage** – the transformer was damaged to point it needed to be replaced |
| | This transformer was identified in December 2010 as having an increasing dissolved gas trend. Oil samples were being taken daily to monitor overall gassing rate and individual gas levels. Since daily monitoring was started, the gassing rate averaged 110 ppm/day. The transformer had been connected to an on-line oil processing skid twice to reduce total dissolved gas levels. An oil sample taken the morning of the failure indicated no | |

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| | unusual gas levels or gassing rate. The transformer had been in service for approximately 23 years. In 1999, it was removed from service for one operating cycle to make internal repairs. Subsequently, during the 2006 refuelling outage, internal repairs were made due to gassing issues. | |

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| ****Consequences** | On 3 March 2011, the main power transformer faulted causing a fire, damage to the transformer and an automatic scram of the unit. Site personnel and the transformer's automatic fire-suppression system, extinguished the fire. All station systems functioned as expected, the station is stable and is in cold shutdown. No personnel injuries occurred and no station equipment, other than the transformer, were damaged. An extended outage occurred (90 days) to procure and replace the transformer. | **Consequences –**<br>• **02 – Station transient** – a reactor trip occurred<br>• **03 – Equipment damage, fires** – the fire occurred when the transformer failed |
| **Report Analysis and Comments** | Initial conditions immediately before and at the time of the fault are as follows:<br>Generator conditions prior to fault (normal):<br>• About 23kA, 23.5kV and 288 field volts<br>Initial fault conditions:<br>• Phase A initial fault current: about 23kA<br>• Phase B initial fault current: about 100kA<br>• Phase A-B initial fault voltage: about 18kV<br>• Phase B-C initial fault voltage: about 3kV<br>Phase B current and phase A-C voltage were not recorded on the fault recorder, so they were not available.<br>The fault recording data indicated that the main power transformer failure initiated with a phase-to-phase fault between phases B and C, on the low-voltage side of the transformer. This is supported by the magnitude of fault current that was seen on the fault recorder on phase C. The current in phase B was not instrumented. While the available data indicated a fault of lesser severity on phase A, it is believed that the transformer did not experience an initial phase-to-ground fault. A phase-to-ground fault would be expected to be limited to about 8 amps by the generator neutral resistor. The fault recording data did not indicate that phase-to-ground faults occurred on phase B and phase C to ground later in the event.<br>Inspection of the transformer prior to disassembly showed that the low-voltage bus bars were distorted and out of position and some were close to the aluminium flux shield. There were obvious | **Systems – 410 – High voltage AC** – the transformer was 23.5kV<br>**Components – 410 – Switchyard equipment (transformers)** – main power transformer failed<br>**Direct Cause – 0201 – Short circuit, arcing** – this states that there were signs of heavy arcing<br>**Group(s) –**<br>**120 – Maintenance** |

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| | signs of heavy arcing between the ends of the phase B and phase C low-voltage bus bars. The amount of copper loss in this area could only have occurred with a high-energy arc. The amount of damage within the transformer made it impossible to determine what the spacing for these components may have been prior to or at the initiation of the event.<br><br>Inspection of the transformer internals noted the major damage appeared to be in the area of phase B on the low-voltage side. Significant burning was found on the flux shields in the specific areas encasing the low-voltage bushings and in the immediate vicinity of the phase B and phase C low-voltage buses. The burning of the flux shields was likely collateral damage from the fault current, as the fault recorder data shows that it lasted for a significant period as the turbine-generator coasted down. Based on the required heat and location, this damage was judged to be due to arcing that took place after the initial event. The degree of burning indicated a fault had occurred that generated high levels of acetylene.<br><br>The problem analysis revealed that the most probable cause of the transformer fault was the failure of the low-voltage bus bar supports to restrain bus bar movement. This allowed the gap between phases B and C to diminish to the point of arc initiation. A root or proximate cause of the failure of the low-voltage bus bar supports could not be identified. From the analysis of the fault data, it is evident that the initiating fault was phase-to-phase rather than phase-to-ground. The physical inspections revealed that there was heavy, high-energy arcing between the phase B low-voltage bus bar and the phase C low-voltage bus bar. No other indications of such phase-to-phase arcing were found.<br><br>It was determined that movement of one or both of the bus bars was the only failure mode that could not be reasonably ruled out. The loss of oil between the two bus bars, displacement of oil with gas between the two bus bars and a loss of the oil's dielectric properties were each evaluated as unlikely causes. This was based on the fact that the transformer gas detector did not actuate prior to the event and the oil sample analysis taken just hours before, produced results for gas content and moisture similar to past results. However, the | **Electrical**<br><br>**210 – Shift – Control room operators**<br><br>**220 – Shift – Field operators**<br><br>**360 – Electrical engineering**<br><br>All of these groups are likely to learn from this event<br><br>**Root Cause – 2302 – Ageing** |

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| | extensive damage in the fault area destroyed the evidence that could have determined that a shifting of one or both of the phases B and C bus bars was the cause. Transformer age, hours of operation under load, movement/transportation and mechanical stresses resulting from through-fault currents, are likely contributors to the failure. The fact that the transformer had experienced multiple through-fault events over its operating life is likely the most significant contributor. | **of component**<br><br>**Causal Factor – 2302 – Ageing of component –** No definitive root cause could be determined, other than the most probable cause. |

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| **Corrective Actions** | 115. Develop a maintenance strategy that requires an evaluation of, and potential internal inspection for, each transformer that experiences a through-fault event prior to its return to service.<br><br>116. Revise or create procedures to incorporate the maintenance strategy developed for a transformer that experiences a through-fault event, prior to its return to service.<br><br>117. Evaluate the need to inspect both Unit 1 and Unit 2 unit auxiliary transformers, the start-up transformers and the Unit 2 main power transformers for cumulative degradation from through-fault events. Provide a recommended schedule and plan for any inspections required.<br><br>118. Review the effectiveness of the corrective actions to prevent recurrence.<br><br>119. In the interim, before the maintenance strategy is developed and incorporated into site procedures, establish a means to ensure that corporate engineering is contacted for assistance in determining actions required, if a through-fault event occurs on a major transformer. | |
| **Note** | **All code fields below should be completed for a WER.** | |
| *** Note** | ***These code fields may contain more than one code.** | |
| **INES Level** | 1 | |
| **Station Status** | 110 – Steady power operation | |
| **Station Activity** | 05 – Normal equipment operation | |
| **Direct Cause** | 0201 – Short circuit, arcing | |
| **Category** | 3 – Major equipment damage | |
| **Consequence(s)*** | 02 – Station transient<br><br>03 – Equipment damage, fires | |
| **System(s)*** | 410 – High voltage AC | |
| **Component(s)*** | 410 – Switchyard equipment (transformers) | |

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| **Group(s)*** | 120 – Maintenance Electrical<br>210 – Shift – Control room operators<br>220 – Shift – Field operators<br>360 – Electrical engineering | |
| **Root Cause(s)*** | 2302 – Ageing of component | |
| **Causal Factor(s)*** | 2302 – Ageing of component | |
| **List Attachments** | List and attach all relevant attachments. | |

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