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**NUCLEAR ENERGY AGENCY
COMMITTEE ON THE SAFETY OF NUCLEAR INSTALLATIONS**

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**Identifying and Overcoming Barriers to Effective Consideration of Human and Organisational Factors in
Event Analysis and Root Cause Analysis**

Workshop Proceedings

**September 21-22, 2009
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The mission of the NEA is:

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- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

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COMMITTEE ON THE SAFETY OF NUCLEAR INSTALLATIONS

Within the OECD framework, the NEA Committee on the Safety of Nuclear Installations (CSNI) is an international committee made of senior scientists and engineers, with broad responsibilities for safety technology and research programmes, as well as representatives from regulatory authorities. It was set up in 1973 to develop and co-ordinate the activities of the NEA concerning the technical aspects of the design, construction and operation of nuclear installations insofar as they affect the safety of such installations.

The committee's purpose is to foster international co-operation in nuclear safety amongst the NEA member countries. The CSNI's main tasks are to exchange technical information and to promote collaboration between research, development, engineering and regulatory organisations; to review operating experience and the state of knowledge on selected topics of nuclear safety technology and safety assessment; to initiate and conduct programmes to overcome discrepancies, develop improvements and research consensus on technical issues; and to promote the co-ordination of work that serves to maintain competence in nuclear safety matters, including the establishment of joint undertakings.

The clear priority of the committee is on the safety of nuclear installations and the design and construction of new reactors and installations. For advanced reactor designs the committee provides a forum for improving safety related knowledge and a vehicle for joint research.

In implementing its programme, the CSNI establishes co-operate mechanisms with the NEA's Committee on Nuclear Regulatory Activities (CNRA) which is responsible for the programme of the Agency concerning the regulation, licensing and inspection of nuclear installations with regard to safety. It also co-operates with the other NEA's Standing Committees as well as with key international organizations (e.g., the IAEA) on matters of common interest.

EXECUTIVE SUMMARY

Nuclear licensees must have effective processes for learning from operating experience in order to manage safety, secure continuous improvement and defend against the potential for repeat events. These processes include root cause analysis (RCA) to identify the underlying causes of events and mechanisms to learn from these analyses and to implement improvements. Correctly identifying and correcting the causes of events will allow lessons to be learned and shared with others in the industry.

The treatment of Human and Organisational Factors (HOF) in RCA is of special interest to WGHOFF. It is estimated that approximately 60-80% of events in the nuclear industry can be attributed to human and organisational factors. Although the importance of correctly identifying the HOF causes is understood, there is still a tendency for the analysis to focus solely on the technical issues of the event. The history of prominent events across the major hazards sector shows that HOF lessons often fail to be learned.

A NEA / CSNI special experts meeting entitled, "Identification of Barriers to Analyzing and Identifying Human and Organisational Factors in Root Cause Analysis," was held at the NEA Headquarters in Paris, France on September 21 – 22, 2009. A total of 17 participants from 10 countries representing licensee organisations, regulators, international organisations and an independent consultant attended the meeting. The meeting was structured to allow for small group discussions during which a number of themes were explored, followed by plenary discussion. There were also four papers presented which complemented the discussion themes.

As set out in the objectives of this work, the participants identified barriers to the effective treatment of HOF in RCA and recommendations to mitigate the effects of these barriers. Many of the barriers and recommendations identified relate to the RCA process in general, not specifically to the treatment of HOF in the RCA process. This is logical, for if the RCA process is not conducted effectively, then the chance of identifying HOF issues is limited.

Senior Management and Organisational Issues

Barriers:

- Events with a clear indication of HOF causes are still described as almost entirely caused by technical factors. Culture related organisational factors are rarely considered in event and incident investigation.
- Senior managers are not typically provided with training in RCA techniques or HOF and may therefore be reluctant to accept report conclusions if HOF issues are identified.
- Organisations may be unwilling to be self critical because of potential repercussions (internal / external).
- HOF issues are typically understood as human performance errors at the individual worker level. The maturity of the organisation affects whether the organisation responds to the individual behaviour or looks to uncover the underlying causes of the behaviour.

- RCA reports submitted to the regulator become accessible to the media and the public. It is often difficult to manage the reaction to the report and ensure that the information is taken in the proper context.

Recommendations:

- Senior management must demonstrate support for the RCA process. This includes a senior management team who is knowledgeable about the RCA process and HOF issues, supports the investigation of HOF issues, and provides the necessary resources to the team.
- Develop and deliver training specifically designed for the senior management team in RCA. The RCA process should indicate that HOF issues are to be considered in investigations.
- Develop a checklist designed for managers for review of RCA reports to enhance quality and consistency.
- RCA teams must have the authority to conduct the RCA without interference. This is particularly important for events involving organisational issues.
- Investigators (lead and team) require assurance that taking part in an investigation will not harm their careers in any way.
- The licensee should not be pressured to produce results prematurely either by internal deadlines or external influences (regulator). This could result in superficial analysis by licensees in order to come up with easy-to-accomplish corrective actions. Organisational issues take time to change.
- A just or blame-free culture is required to support the identification of HOF in RCA. Individuals should feel free to report errors and unsafe conditions without fear of reprisals.
- The content of licensee RCA reports may become accessible to the public and the media once formally submitted to the regulator. It may be prudent to reach an agreement between the regulator and the licensee on how such reports will be handled. Care must be taken to ensure that conditions do not develop where the licensee is reluctant to submit comprehensive reports for fear of information being taken out of context by the media.

Systematic Methodology and Tools:

Barriers:

- Participants felt that a lack of formal or adequate training in RCA methodologies and HOF issues is the primary factor in limiting the effectiveness of the available analytical tools. Most analytical tools are not used correctly or pursued to the point where HOF issues can be identified.
- A lack of time will affect the ability (willingness) to investigate an event further to identify potential HOF issues versus settling for a superficial result.
- The scope of the investigation will determine if HOF issues will be analyzed. Senior management support is essential if the scope of the RCA is to include an analysis of HOF issues.
- RCAs which identify HOF issues may be perceived to be subjective and tend to be cross-functional affecting many parts of the organisation. There is a tendency to focus on what can be fixed easily identifying quantitative versus qualitative results. The burden of proof for HOF issues may be higher.
- The identification of organisational issues through an Apparent Cause Evaluation is unlikely.
- Many organisations fail to investigate the extent of condition or extent of cause of an event, particularly with respect to organisational issues.

- It can be difficult to identify specific, measurable and effective correct actions for HOF causes of events. This may lead to questions as to whether the RCA was correct in the first place.

Recommendations:

- Provide clear instructions and examples for investigators on how to use the available tools to identify HOF issues in the RCA process. A systematic use of the analysis tools to gather factual data will support the credibility of the conclusions reached.
- Use multiple analysis tools in an investigation involving HOF to ensure convergent validity of data to support conclusions. This will legitimize the identification of HOF issues and avoid the perception of subjective results.
- “Human error” is not a root cause but an outcome of behaviours. Organisations should not accept “human error” as a root cause but explore the organisational factors to understand why an individual may have acted as they did.
- In RCA training, use case studies where HOF issues have had significant implications in order to educate and raise awareness in the organisation (e.g. Columbia Space Shuttle, Piper Alpha etc.)
- Develop a formal trending program which integrates the results of low level event investigations, self assessment, safety culture surveys, and external reviews to build a picture of the HOF issues in the organisation.
- Conduct an extent of condition and extent of cause analysis for those events which involve HOF.
- Ensure that those with responsibility for implementing corrective actions understand the facts which support the conclusions reached by the investigation team.
- Establish a consensus of terms and their definitions within the organisation and with the regulator.

Team Composition / Learning

Barriers:

- Investigator skill in RCA methodology and HOF knowledge is necessary to identify HOF issues.
- It is an increasing challenge to develop and maintain investigator skills as fewer and fewer RCAs are done per year. An informal survey of the participants indicates that on average, 2-3 RCAs are conducted per unit per year.
- A lack of RCAs conducted may limit the opportunities for learning from the identification of organisational issues.
- The level of management sponsor assigned to a RCA team is important to ensure that the scope of the investigation includes a consideration of the HOF causes and that cross functional organisational units are considered.
- Measuring the effectiveness of corrective actions implemented to address HOF causes of events may take time to observe measurable improvements. In the absence of immediate and measurable improvements, the organisation may be reluctant to accept report conclusions identifying HOF causes.

Recommendations:

- Develop a RCA training qualification program with both a knowledge and skill component. Investigators should conduct 2-3 RCA investigations per year in order to maintain their competence.
- Ensure that HOF training provided for RCA investigators is conducted by an individual with HOF expertise and knowledge.
- A HOF specialist should be on the RCA team or available for consultation if the team leader does not have HOF expertise.
- There should be close collaboration between RCA analysts and HOF specialists. Specialists in these areas should be located physically close together within the organisation to facilitate relationship building.
- The organisational level of the management sponsor assigned to a RCA investigation should be commensurate with the significance of the event.
- Review corrective actions to confirm implementation and for effectiveness in addressing the root cause. The corrective actions for organisational issues may take a long time to take effect.
- Communicate the results of an RCA investigation to promote understanding of the event in the organisation and to encourage learning

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INTRODUCTION

Nuclear licensees must have effective processes for learning from operating experience in order to manage safety, secure continuous improvement and defend against the potential for repeat events. These processes include root cause analysis (RCA) to identify the underlying causes of events and mechanisms to learn from these analyses and to implement improvements. Correctly identifying and correcting the causes of events will allow lessons to be learned and shared with others in the industry.

The treatment of Human and Organisational Factors (HOF) in RCA is of special interest to WGHOE. It is estimated that approximately 60-80% of events in the nuclear industry can be attributed to human and organisational factors. Although the importance of correctly identifying the HOF causes is understood, there is still a tendency for the analysis to focus solely on the technical issues of the event. The history of prominent events across the major hazards sector shows that the HOF lessons often fail to be learned.

WGHOE determined that further work was needed to explore the following issues:

- What are the barriers which prevent the adequate treatment of HOF in RCA?
- Do root cause investigators have sufficient knowledge and experience of HOF?
- Do the RCA training and methodologies available adequately address HOF aspects of event analysis?
- Where HOF weaknesses are identified are they difficult for management to deal with such that corrective measures are not always implemented effectively?

The conclusions of the 2006 CNRA/ WGOE (Committee on Nuclear Regulatory Activities / Working Group on Operating Experience) meeting in Cologne, Germany called for WGHOE to consider the treatment of HOF in events and RCA. This special experts meeting provides some insights and recommendations to improve identification of HOF in RCAs.

BACKGROUND

The main mission of the Nuclear Energy Agency (NEA) Working Group on Human and Organisational Factors (WGHOFF) is to improve the understanding and treatment of human and organisational factors (HOF) within the nuclear industry in order to support the continued safety performance of nuclear installations and improve the effectiveness of regulatory practices in member countries.

WGHOFF developed a CSNI (Committee on the Safety of Nuclear Installations) Activity Proposal Sheet (CAPS) outlining the work and milestones necessary towards achieving the following objectives:

- Identify barriers to analyzing and correctly identifying the Human and Organisational Factors (HOF) causes of events;
- Identify barriers to implementing lessons learned from these analyses; and
- Develop recommendations for overcoming these barriers to
 - improve the identification of HOF causes of events and
 - support the successful implementation of appropriate corrective actions

The CAPS can be found in Appendix A.

The first activity under the plan was the development of a questionnaire. This was distributed to WGHOFF members and their counterparts from the Working Group on Operating Experience (WGOE). The questionnaire was comprised of 20 questions based on the objectives of the CSNI Activity Proposed Sheet. The intended survey participants were licensees with previous experience conducting root cause analyses. Responses were received from 26 respondents from 11 different countries. The results of the questionnaire were analyzed to identify themes for further discussion during a specialist meeting planned for September 2009. The following themes were presented during the WGHOFF meeting in March of 2009 and endorsed for further work:

- Roles and Influence of Senior Management
- Skills and Knowledge of the Investigators
- Qualitative Nature of HOF
- Influence of the Regulator
- Systematic Approach to Investigation

A summary of the questionnaire responses is provided in Appendix B.

SPECIAL EXPERTS MEETING STRUCTURE

A NEA / CSNI special experts meeting was held at the NEA Headquarters in Paris, France on September 21 – 22, 2009. The meeting was entitled, “Identification of Barriers to Analyzing and Identifying Human and Organisational Factors in Root Cause Analysis.” (See Appendix C for the meeting announcement.) A total of 17 participants from 10 countries representing licensee organisations, regulators, international organisations and an independent consultant attended the meeting. The intention was to ensure that experts with practical experience in RCA, HOF and senior managers of licensee organisations were in attendance. The number of participants was limited to ensure optimum interaction and discussion amongst the participants. One of the participants was also a member of the CNRA Working Group on Operating Experience. The meeting agenda is presented in Appendix D and a list of participants is included in Appendix E.

As mentioned previously, an analysis of the questionnaire responses identified five themes. These themes were then used to generate questions for further discussion during the special experts meeting. The questions were discussed in one of the three small group sessions. All of the five themes initially identified by analysis of the questionnaire responses were captured within one of the three discussion sessions.

- **Senior Management / Organisational Issues** (Role and Influence of Senior Management; Influence of the Regulator)
- **Systematic Use of Methodology and Tools** (Systematic Approach to Investigations; Qualitative Nature of HOF)
- **Team Composition / Learning** (Skill and Knowledge of the Investigators)

Each small group had a facilitator to lead the discussion. The groups were also tasked with identifying specific recommendations to improve the treatment of HOF in RCA relative to the issues discussed. The group conclusions and recommendations were summarized on PowerPoint slides and presented to the larger group for discussion. A copy of the small group responses for each session is provided in Appendix F. The main messages from the presentations and results from the small group discussions are summarized in the next section.

There were also four papers presented during the special experts meeting. The four presentations and the corresponding papers are included in Appendix G.

SUMMARY OF THE SPECIAL EXPERTS MEETING

Day One

The workshop began with an overview of the Nuclear Energy Agency (NEA), Committee for the Safety of Nuclear Installations (CSNI) and a description of the mission and recent projects of the Working Group on Human and Organisational Factors (WGHO). The history of the project work to date was described and the objectives for the workshop presented. An overview of the results of the questionnaire and the five themes for the upcoming sessions were presented. A generic model of the corrective action process was discussed in order to ensure all participants had a common starting point for discussion. (Appendix H)

Paper One (Appendix G)

Dr. Atoosa Thunem from the OECD Halden Reactor Project presented a paper entitled “The Role of Organisational Factors in Event Reporting and Incident Investigation.” Dr. Thunem and her colleagues have completed an extensive review of root cause analysis reports and have identified a number of key points of relevance to the special experts meeting:

- The great majority of barriers to analyzing and identifying human and organisational factors during RCA originate in organisational causes. These causes are primarily cultural in nature and thus are deeply rooted.
- Culture related organisational factors are rarely considered in event and incident investigation.
- Events with a clear indication of HOF causes are still described as almost entirely caused by technical factors.
- Incompetence or lack of experience of the workers involved is often represented as a cause of the incident.
- Organisational issues if identified are at structural level, e.g. insufficient resources, unclear definition of roles and responsibilities, poor work practices and procedures etc. The reasons for these structural problems are not investigated and so the organisational culture factors remain hidden.
- The expertise of the analyst plays a crucial role in the consideration of the culture oriented aspects of the event investigation.

Small Group Discussion # 1: Senior Management/Organisational Issues

*Who in the organisation is responsible for RCAs? What level and line within the organisation are they?
Who approves RCAs?*

Line organisations are typically responsible for conducting investigations related to their functional areas. The line organisation has a large role to play and should “own” the investigation. This approach promotes

internalization of the results and commitment to improvements. For significant events, RCAs may be conducted by those external to the line organisation with input from the line organisation. RCA reports are often reviewed by those not directly involved in the investigation, but are within the same organisation. Reports are typically reviewed and signed off by senior management and/or the plant head.

Do senior managers understand the RCA process? Do senior managers understand organisational issues? How is the identification of organisational issues treated? What value is placed on the RCA process? What challenges have you encountered with senior management buy in?

Managers are not typically trained in root cause analysis (RCA) techniques or human and organisational factors (HOF). The participants felt that while managers have a general understanding of the benefits of the RCA process many do not see this as a valuable investment of resources. It was suggested that some managers may develop an understanding of HOF as part of their management training however this was not common. The management training provided may include human performance issues but safety culture or organisational culture issues are often not addressed in any depth.

Senior managers typically review and approve RCA reports. If these managers are provided with limited training on the RCA process and do not have the opportunity to develop an understanding of HOF, they may fail to understand the reports they are approving. Senior management may not ask challenging questions about possible safety culture or organisational culture contributors of the investigative team which would otherwise ensure completeness and improve the quality of the report. They may be reluctant to accept the report conclusions if HOF issues are identified, because of a lack of understanding of the RCA process or the HOF issues involved.

Many organisations are reluctant to identify HOF issues through the RCA process for a variety of reasons - for example, there may be personal or organisational resistance to change, managers may be part of the problem, they may be afraid of the consequences (media, regulatory follow-up), and they may feel that corrective actions are more difficult to identify and measure.

Are there any regulatory requirements or influence?

Most countries have regulatory requirements to conduct RCA for significant events. The United States Nuclear Regulatory Commission (USNRC) encourages licensees to consider safety culture aspects in the RCA for a significant event. Several regulatory bodies have requirements to review the RCA process every few years, some following guidelines, others through discussion. As identified in the survey, those organisations with regulatory requirements to have HOF expertise in-house tended to have HOF expertise on RCA teams as a regular practice.

A number of the participants indicated that discussion between the licensee and regulator about the results of an RCA can be positive. The regulatory or external point of view may identify organisational issues previously missed by the licensee. This response was common in countries where regular and open dialogue occurs between the licensee and regulator on all matters.

- Other participants indicated that reports submitted to the regulator will generally receive more internal scrutiny and that issues identified in the RCA report may be downplayed. There are several reasons for this:
- Issues identified in investigation reports may consequently receive additional regulatory oversight and the regulator may closely monitor licensee progress on the issue.

- Some participants indicated that the regulator may initiate regulatory actions based on RCA investigation results.
- Reports sent to the regulator may become available to the public and the media. Some participants shared experience where the information in these reports had been taken out of context and misunderstood by the media. They noted that once a report becomes public it is often more difficult to manage the reaction to the report and ensure that the information is taken in the proper context.

One of the purposes of the RCA process is for the licensee is to learn from their own experience and that of others. Indiscriminate use of findings identified through the RCA process to initiate regulatory actions will not promote or encourage self-critical behaviours on the part of the licensee. These behaviours are necessary to ensure the investigation identifies any more difficult to determine organisational issues which may be contributing to events or trends. Alternately, it is the job of the regulator to identify deficiencies to the licensees and request that remedial action be taken. Obviously there must be a balance between these two competing objectives.

Does the culture of the organisation affect RCA? If so how? What type of culture supports identification of HOF in RCA? How do you create/sustain this culture?

The maturity of the organisation and the senior management is important for implementing a successful RCA process. This maturity will affect the depth of an investigation and the ability and willingness to identify organisational issues. For example, if a human performance problem is identified, the maturity of the organisation affects whether the organisation responds to the individual's behaviour or looks to uncover the underlying cause of the behaviour. If time pressures on the investigative team are excessive, the investigative results may be more superficial. In these instances the investigation may stop with the identification of individual performance issues rather than taking more time (and resources) to analyze the underlying conditions which allowed the event to occur. A mature organisation will encourage a thorough analysis to uncover the underlying organisational issues which may have contributed to the event.

The organisation must have a "blame-free" or "just" culture in order to support the identification of HOF in RCA. A constructive culture in a learning organisation will help to support the RCA process. This means that individuals must feel free to self report errors without fear of consequences. The investigation team must have the resources and authority to conduct the investigation without interference and without fear of reprisal.

Recommendations:

The participants identified the following recommendations for this discussion topic:

- Senior management must demonstrate support for the RCA process. This includes a senior management team who is knowledgeable about the RCA process and HOF issues, supports the investigation of HOF issues, and provides the necessary resources to the team.
- Develop and deliver training specifically designed for the senior management team in RCA. The RCA process should indicate that HOF issues are to be considered in investigations.
- Develop a checklist designed for managers for review of RCA reports to enhance quality and consistency.

- RCA teams must have the authority to conduct the RCA without interference. This is particularly important for events involving organisational issues.
- Investigators (lead and team) require assurance that taking part in an investigation will not harm their careers in any way.
- The licensee should not be pressured to produce results prematurely either by internal deadlines or external influences (regulator). This could result in superficial analysis by licensees in order to come up with easy-to-accomplish corrective actions. Organisational issues take time to change.
- A just or blame-free culture is required to support the identification of HOF in RCA. Individuals should feel free to report errors and unsafe conditions without fear of reprisals.
- The content of licensee RCA reports may become accessible to the public and the media once formally submitted to the regulator. It may be prudent to reach an agreement between the regulator and the licensee on how such reports will be handled. Care must be taken to ensure that conditions do not develop where the licensee is reluctant to submit comprehensive reports for fear of information being taken out of context by the media.

Paper 2 (Appendix G)

Following the large group discussion, a second presentation was provided by Kay Gallogly of The 42 Group. This presentation set the scene for the second discussion session. In her presentation “Using a Systematic Approach to Identifying Organisational Factors in Root Cause Analysis,” the author observed that:

- Investigators do not see the connection between the analysis tools available and the identification of HOF. Most investigators use the tools in a cursory manner and so do not derive the full benefits of the tools. Some tools are used for presentation purposes as opposed to being used for analytical purposes e.g. event and causal factors charts. In some cases, the report will indicate that specific analytical tools were used in the investigation but the analysis is not in the body of the report.
- Some investigators are documenting HOF causes but do not recognize them as such. This indicates a lack of understanding of HOF.
- Others investigators focus on technical issues because of their own comfort level.
- The culture of the Organisation will affect the depth of the investigation and therefore the use of the analytical tools to pursue HOF issues.
- The author contends that if analysis tools are applied systematically to gather factually based data, then HOF issues can be identified. The use of factual information (without judgement and subjectivity) is important to maintain the credibility of the investigation especially when HOF issues are identified.
- Systematic use of tools assists in better communication of the issues to foster greater understanding and acceptance by senior management.
- Barrier Analysis, Change Analysis, and TWIN (Task Demands, Work Environment, Individual Capabilities, and Human Nature) all offer the opportunity to identify HOF issues if the analyst pursues this line of investigation. It was illustrated that many elements of the TWIN Error Precursors are themselves Organisational in nature.
- The TWIN model applied to the Anatomy of an Event will help to distinguish those which are Organisational issues (Latent Organisational Weaknesses, Error Precursors and Flawed Defences) and those which are human factors (Active Errors).

- Barriers to the identification of HOF in an event investigation may lie with the individual analyst or within the organisation.

The participants then returned to their small groups to discuss the questions related to the second session. The questions discussed during this session were organised under the heading of **Systematic Methodology and Tools**.

End of Day One

Day Two

The first activity on Day Two was a summary and discussion of the issues arising from the previous day's session.

Small Group Discussion # 2 Systematic Methodology and Tools

What are the challenges in using the available analysis tools for identification of HOF in RCA? Are they used effectively? Are the available tools able to identify HOF issues? Are certain methods better than others? Why?

The participants described a number of challenges in using the available tools for the identification of HOF in RCA. A lack of formal or adequate training in RCA methodologies and HOF issues is seen as the primary factor in limiting the effectiveness of the available analytical tools. Participants indicated from their experience that current methodologies require supplementary analysis tools and techniques to uncover HOF issues, which suggests that the current analytical tools are not used as effectively as possible.

Another challenge to the effectiveness of the process is the time and resources available to conduct an RCA investigation. A lack of time will affect the ability (willingness) to investigate an issue further versus settling for a superficial result. Most investigators have other jobs which potentially compete for their time and energy. Investigators may not be as thorough in their investigation if they know that the work of their regular job is not being done in their absence.

The scope of the RCA established at the beginning of the investigation will affect the extent to which HOF issues will be identified. It will determine the depth of the analysis and the time available to investigate HOF issues. Senior management support is essential if the scope of the RCA is to include an analysis of HOF issues.

Participants indicated that very few RCAs are conducted at facilities. This limits the development of RCA skills, particularly as they apply to identification of HOF issues. This is particularly evident in smaller organisations where the availability of resources to conduct RCAs is even more challenged.

A variety of investigative tools are used by the participants such as HPES, Barrier Analysis, MORT, TapRoot, Task Analysis, ECFC etc. The group did not discuss whether certain methods were better than others in identifying HOF in RCA. Each method has its own relative strengths.

How do you "handle" the perceived qualitative/subjective nature of HOF? Are you able to generate factual information to support conclusions?

Root causes which are linked to HOF issues are often perceived as subjective and tend to be cross-functional affecting many parts of the Organisation. There is a tendency to focus on what can be fixed easily identifying quantitative versus qualitative results. A systematic use of the available tools by skilled investigators to generate factual information will help to support the conclusions. This is not any different from any other RCA investigation. What may be different is that the burden of proof for HOF issues may be higher. For example, a greater number of factual pieces of information may be necessary to support the conclusions drawn. It is essential to use available tools in a systematic way to address HOF and legitimize the investigation in this area. It is particularly important that HOF conclusions are well supported due to the perception of subjectivity. The use of case studies to illustrate where HOF played a significant role

will raise awareness of the need to conduct similar in-depth investigations within the organisation (e.g. Columbia Space Shuttle).

Is the vocabulary used in RCA methodologies consistent? Has this created difficulties?

The vocabulary used in RCA methodologies by licensees, regulators and experts is not consistent. This has created difficulties in developing a common understanding of the importance and meaning of some terms. Participants felt very specific language is used by HOF specialists, which is not always understood by RCA investigators. Vocabulary is seen as too academic or abstract. This creates difficulties in identifying similar events for the identification of trends, communication within the organisation and with other stakeholders and during regulatory review. A common understanding is needed between the licensee and the regulator in order to facilitate discussion. As a minimum, this must start with use of a consistent terminology within the licensee organisation.

Will organisational issues be identified in analyses less intensive than RCA?

For less significant events, some licensees use an Apparent Cause Evaluations (ACE) approach. ACE investigations are narrowly focused, rapid assessments typically using a single tool (e.g., barrier analysis) and performed by a single investigator, who may or may not have formal training in RCA. ACEs are unlikely to identify organisational issues by their very nature. An ACE would have a very limited scope and would typically only address the issues relating to the immediate line organisation. The purpose of this type of analysis is to fix the current issue, not necessarily prevent recurrence of events with similar causes.

A skilled and knowledgeable analyst reviewing multiple events of this level of significance may be able to identify underlying organisational issues. Specific HOF codes if not already available would be needed for this sort of analysis. The organisation would have to allocate the resources for this activity. Many organisational factors can be identified through other means such as self-assessments, internal/external audits, change management analyses etc. This suggests that a mechanism for integrating the results of different assessment types could be used to identify organisational issues before they become events.

Are you able to identify organisational issues from a single event?

Organisational issues can be identified from a single significant event if an RCA is conducted. For less significant events where a less rigorous investigative technique is used, it will be more difficult to identify organisational issues. If organisational issues cannot be substantiated through evidence collected from a single event investigation, the issue can at least be identified for further follow up.

Is an extent of condition/extent of cause analysis always done?

Participants did not understand the meaning of these terms at first and so explanation was required. After discussion it appears that the reason for the need to define the terms for participants is that most organisations do not conduct these reviews, particularly when organisational issues are identified. Such analysis may be done for equipment issues, depending upon the importance of the system involved. If an extent of condition or extent of cause analysis is conducted it is usually not done very well. It might be conducted if there are similar or repeat events but the definition of a similar or repeat event is also subject to interpretation. The lack of this type of review suggests that many organisations fail to investigate the prevalence of the condition and its causes within the organisation, particularly with respect to organisational issues.

Is it difficult to make a clear link between RCA and Corrective Actions?

Identification of effective corrective actions for HOF causes of events can be more difficult than identifying a corrective action for an equipment related cause. Fixing a pump is easier than improving the culture of an organisation. When HOF issues are identified, the resources required to implement the most appropriate corrective action may be perceived to be too costly and the benefits may be difficult to measure. A discussion between those who must implement the corrective actions and the investigators to confirm understanding of the facts and resultant actions is necessary.

Difficulty in identifying a specific and measureable corrective action for HOF issues may lead to questions as to whether the RCA was correct in the first place. The corrective actions to address HOF issues tend to take much longer to implement and to observe improvements than for equipment related causes. Licensees (and regulators) must be careful to ensure that a quick fix is not implemented simply because the results are easily identified and measured. It is important when HOF issues are identified to return to the issues after the corrective action has been implemented for some time to see if the actions have been effective in addressing the issue and preventing recurrence.

Recommendations:

Many of the recommendations stated relate to the conduct of an RCA in general and are not specific to those dealing with HOF issues. However, if the RCA is not conducted effectively, there will be difficulty identifying the root cause, especially if HOF issues are involved. The participants provided the following recommendations:

- Provide clear instructions and examples for investigators on how to use the available tools to identify HOF issues in the RCA process. A systematic use of the analysis tools to gather factual data will support the credibility of the conclusions reached.
- Use multiple analysis tools in an investigation involving HOF to ensure convergent validity of data to support conclusions. This will legitimize the identification of HOF issues and avoid the perception of subjective results.
- “Human error” is not a root cause but an outcome of behaviours. Organisations should not accept “human error” as a root cause but explore the organisational factors to understand why an individual may have acted as they did.
- In RCA training, use case studies where HOF issues have had significant implications in order to educate and raise awareness in the organisation (e.g. Columbia Space Shuttle, Piper Alpha etc.).
- Develop a formal trending program which integrates the results of low level event investigations, self assessment, safety culture surveys, and external reviews to build a picture of the HOF issues in the organisation.
- Conduct an extent of condition and extent of cause analysis for those events which involve HOF.
- Ensure that those with responsibility for implementing corrective actions understand the facts which support the conclusions reached by the investigation team.
- Establish a consensus of terms and their definitions within the organisation and with the regulator.

Paper 3 (Appendix G)

The third paper was presented by Dr. Petri Koistinen, a HOF and Safety Culture Specialist at TVO in Finland. In his presentation, he described the work he does in his area as it relates to HOF and RCA. His paper is called “Doing HOF work in NPP – an Internal Specialist Point of View.” The following are the key points from his presentation:

- Koistinen has been an internal HOF specialist since 2004; still the only HOF specialist at TVO.
- Main duties are event investigations (including RCA), operating experience, safety culture improvement, human performance and organisational development issues.
- Human error is typically the end point of an investigation – Koistinen’s job is to find out what has led a good professional to make an error (organisational factors).
- A blame-free or just culture is required to identify the organisational issues in an event.
- RCA is used for the most serious events – about 5 RCA like investigations are conducted at the two TVO units per year.
- Finland does not have RCA training available and so staff must go elsewhere. Those working in event investigations are usually new in the nuclear business and therefore lack experience.
- The author presents a number of guidelines from STUK, the Finnish regulatory body. There are requirements for competence of investigators, resources and use of multiple data sources to reach conclusions.
- TVO conducts about 15-20 event investigations per year which are less rigorous than an RCA. These are usually conducted by the line organisation. Reports are reviewed by Human and Organisational Factors, Organisational Effectiveness and Quality Assurance personnel before they are accepted.
- The HOF specialist is always part of an RCA investigation team.

Paper 4 (Appendix G)

Dr. Ryuji Kubota of the Japan Nuclear Energy Safety Organisation (JNES – Technical Support Organisation) gave the fourth presentation. In his paper, “Japanese Situations to Emerging Themes” Dr. Kubota described activities currently underway in Japan in this area. The following are the key messages from his presentation:

- In December of 2007, the Japanese government issued a requirement for electric utilities to implement an RCA process as one of the licensee’s Fitness for Safety Activities.
- The regulatory body requires that the licensees ensure the following characteristics for their RCAs:
 - Neutral investigation team
 - Objective data for analysis
 - Logical method for analysis of data
 - The licensee shall present a systematic analysis of the data which considers organisational factors and their causal relationship
- The regulatory body has audited more than 10 cases of RCA implementation and will continue to follow up. It is still too early to measure the effectiveness of the corrective actions with respect to HOF.

- For many years licensees have identified technical and human factors but they have limited experience identifying organisational factors as this requirement was only introduced in December 2007.
- JNES has prepared the JNES Organisational Factors List (JOFL). This is to be used when conducting an RCA to identify the organisational factors causes of events.
- The Mihama accident of 2004 pointed to defects in safety culture and management.
- Organisational factors were identified in the JCO criticality accident by expanding the causal classification list to include the organisational viewpoint. The regulatory body has now instructed licensees to expand their focus to include the organisational view point and it appears that RCA implementation has improved.
- The regulatory body also requires an analysis of the trending of lower level of events and then identification of the common organisational issues through RCA.
- JNES will likely develop indicators to measure the effectiveness of corrective actions.

Small Group Discussion # 3 Team Composition/Attributes and Learning

The third and final small group session looked in depth at the characteristics and training required of investigators. The groups also discussed issues of learning as it relates to RCA.

What are the challenges associated in team/individual competence? Training? Personal attributes? Skill? Experience? Credibility? Team composition? How would you choose who would be on a team?

The team leader should have a specific RCA training qualification. It was suggested that RCA training qualifications should be supported by a requirement to conduct 2-3 RCA investigations per year in order to maintain competence. Some participants felt the team leader should have management experience and ideally HOF expertise. The skill of the lead investigator is critical to the outcome of the investigation. The lead must be independent, strong-willed, a good writer/interviewer, and knowledgeable of plant processes and systems.

The lead must understand the need for other specialists on the team and should choose individuals with the right mixture of skill and attitude. A multi-disciplinary team with expertise in relevant disciplines is required for the investigation team. The team should have a HOF specialist as either a dedicated team member or available for consultation if the team leader does not have HOF expertise.

Is there management representation on the team? Is there HOF expertise on the team?

There were mixed opinions about management involvement on the investigation teams. Some groups indicated that experienced managers should lead investigations if the event is significant enough. Others indicated that managers should not be involved in the data gathering phase but could assist in data analysis and in developing practical corrective actions. Some participants indicated those involved in the event would feel more comfortable speaking freely without a manager present.

If HOF expertise is available within the organisation, it is usually included for a RCA investigation. In Spain this is always done where there is an obvious HOF dimension. Other countries used a variety of approaches, with many obtaining HOF expertise if considered necessary.

Does the level of management sponsor affect the willingness of the organisation to accept the HOF in RCA?

A management sponsor is usually assigned to the investigation team to help determine the scope of the investigation, facilitate access to information and ensure progress. A sponsor acts as the liaison between the investigation team and senior management but are not typically involved in the data gathering process. The sponsor may assist the team in developing corrective actions for the root causes and helps to ensure that those who will be assigned the responsibility for corrective action implementation understand the background and importance of the root causes.

The organisational level of the management sponsor assigned to the investigation team should be commensurate with the significance of the event. For significant events with either an actual or potential safety implication, a more senior manager should be assigned. This reflects the importance the organisation places on the RCA process and the commitment to address the issues. A high level management sponsor will have the authority to ensure that HOF issues are addressed and that the investigation includes the necessary organisational areas.

Are RCA results presented to management? Who presents? (lead, sponsor, other)?

There are many different forums for presentation of events. Typically the team lead or management sponsor will present a review of the investigation report to the management team. Broad management review was seen as critical for significant events. Sometimes this is carried out before the report has been finalized to allow for challenges to the conclusions or to the adequacy of the investigative process. In other cases the report is presented only after complete. Some participants indicated that the lead of the HOF group presents the results to management demonstrating the importance of HOF involvement at the team lead level.

How many RCAs are done in a year? Is this a sufficient number to sustain the skill and expertise of investigators? Is this a sufficient number to identify organisational issues?

There are varying levels of analysis performed from a full team RCA investigation, a less rigorous Apparent Cause Evaluation, to trending only. On average it appears that only 2-3 full RCA investigations are conducted per unit per year. Through a limited review of data, it seems licensees are doing fewer and fewer root cause analyses each year.

With so few opportunities for conducting RCAs per year, it will be a challenge to develop and maintain the skills and expertise of the investigators. This may be considered adequate if the same group is conducting all of the investigations in the organisation. This may not be considered sufficient to sustain skills and proficiency if RCAs are done by different groups or the line organisations conduct the investigation. This level of involvement becomes very difficult in smaller organisations with fewer events and potentially fewer dedicated and skilled resources to perform the analysis.

The small number of RCAs conducted may also limit the learning possibilities in the identification of organisational issues. The results of the RCA investigations should be integrated with other sources of information such as ACEs, trending, self assessments, safety culture surveys, external reviews etc. to build a picture of HOF issues in the organisation.

Could you identify organisational issues using the "ACE" method? Would there be any value/information learned from this?

This question was addressed in the previous section. The participants did suggest that the collection of data using the ACE method may identify organisational issues but only when coupled with an effective review and trending process. The analysis may not be perfect but numbers of events identifying a specific issue would be important. The organisation must be willing to initiate HOF based investigations when such trends are identified.

Are events with HOF issues trended in your organisation? What is done when trends are identified?

Events with low significance are typically trended in the participant countries but the identification of HOF is a challenge because the methods don't explicitly identify HOF issues. An analyst would need to review events with HOF concepts in mind to identify such issues from trends.

Most participants use the results of their identified trends to feed into their inspection program for the coming year. If a significant issue is identified, it will be dealt with immediately. In some cases, the results of these identified trends are shared with the regulator who may also conduct a trend analysis of events.

How do you know you have a learning organisation?

You know you do not have a learning organisation when you observe the following:

- Poor corrective action completion
- Actions predominately address training/procedures
- Repeat events
- Little feedback on investigation report results to plant staff
- Lack of timeliness of information provided to others (OPEX shared)

You have a learning organisation if you observe many of the following (every day):

- OPEX is evaluated/used on a regular basis
- Benchmarking is conducted with other organisations
- Safety seminars/meetings are held and attended
- Deficiencies and near misses are self-reported
- Periodic comparison to standards (e.g. OSART)
- Sufficient depth of analyses of events, self assessments etc.
- Systems in place to identify and retain knowledge.

How do you/can you measure effectiveness of corrective actions? Who does this? What happens if the corrective action is deemed to be ineffective?

Participants indicated that it was difficult but important to measure the effectiveness of corrective actions. Several participants discussed looking for repeat events but the definition of a repeat event and the willingness of the organisation to identify similarities have an impact on the success of this approach. The impact on performance of the corrective actions can be examined by reviewing safety indicators and specific process indicators. This should also be followed up by other processes such as audits or self assessments to confirm the effectiveness of corrective actions. The success of the corrective actions may also be reflected in an improving trend of less significant events. External evaluations conducted by third parties (e.g. IAEA, WANO) may also be used.

Once corrective actions are implemented, the organisation must allow some time before the effectiveness of these measures is assessed. Six months may not be sufficient time as corrective actions for root causes which involve HOF will typically take longer to affect changes in performance than improvements to equipment. The implementation of a corrective action does not necessarily mean that the corrective action is effective or that the root cause has disappeared or been resolved. Therefore careful checks are required to ensure effective mitigation of root causes.

Recommendations:

- Develop a RCA training qualification program with both a knowledge and skill component. Investigators should conduct 2-3 RCA investigations per year in order to maintain their competence.
- Ensure that HOF training provided for RCA investigators is conducted by an individual with HOF expertise and knowledge.
- A HOF specialist should be on the RCA team or available for consultation if the team leader does not have HOF expertise.
- There should be close collaboration between RCA analysts and HOF specialists. Specialists in these areas should be located physically close together within the organisation to facilitate relationship building.
- The organisational level of the management sponsor assigned to a RCA investigation should be commensurate with the significance of the event.
- Review corrective actions to confirm implementation and for effectiveness in addressing the root cause. The corrective actions for organisational issues may take a long time to take effect.
- Communicate the results of an RCA investigation to promote understanding of the event in the organisation and to encourage learning.

CONCLUSIONS

This section summarizes the main conclusions of the specialist meeting regarding the barriers to the effective treatment of HOF in RCA. Many of the barriers and recommendations identified relate to the RCA process in general, not specifically to the treatment of HOF in the RCA process. This is logical, for if the RCA process is not conducted effectively, then the chance of identifying HOF issues is limited.

Senior Management and organisational Issues:

Barriers:

- Events with a clear indication of HOF causes are still described as almost entirely caused by technical factors. Culture related organisational factors are rarely considered in event and incident investigation.
- Senior managers are not typically provided with training in RCA techniques or HOF and may therefore be reluctant to accept report conclusions if HOF issues are identified.
- Organisations may be unwilling to be self critical because of potential repercussions (internal / external)
- HOF issues are typically understood as human performance errors at the individual worker level. The maturity of the organisation affects whether the organisation responds to the individual behaviour or looks to uncover the underlying causes of the behaviour.
- RCA reports submitted to the regulator become accessible to the media and the public. It is often difficult to manage the reaction to the report and ensure that the information is taken in the proper context.

Recommendations:

- Senior management must demonstrate support for the RCA process. This includes a senior management team who is knowledgeable about the RCA process and HOF issues, supports the investigation of HOF issues, and provides the necessary resources to the team.
- Develop and deliver training specifically designed for the senior management team in RCA. The RCA process should indicate that HOF issues are to be considered in investigations.
- Develop a checklist designed for managers for review of RCA reports to enhance quality and consistency.
- RCA teams must have the authority to conduct the RCA without interference. This is particularly important for events involving organisational issues.
- Investigators (lead and team) require assurance that taking part in an investigation will not harm their careers in any way.

- The licensee should not be pressured to produce results prematurely either by internal deadlines or external influences (regulator). This could result in superficial analysis by licensees in order to come up with easy-to-accomplish corrective actions. Organisational issues take time to change.
- A just or blame-free culture is required to support the identification of HOF in RCA. Individuals should feel free to report errors and unsafe conditions without fear of reprisals.
- The content of licensee RCA reports may become accessible to the public and the media once formally submitted to the regulator. It may be prudent to reach an agreement between the regulator and the licensee on how such reports will be handled. Care must be taken to ensure that conditions do not develop where the licensee is reluctant to submit comprehensive reports for fear of information being taken out of context by the media.

Systematic Methodology and Tools:

Barriers:

- Participants felt that a lack of formal or adequate training in RCA methodologies and HOF issues is the primary factor in limiting the effectiveness of the available analytical tools. Most analytical tools are not used correctly or pursued to the point where HOF issues can be identified.
- A lack of time will affect the ability (willingness) to investigate an event further to identify potential HOF issues versus settling for a superficial result.
- The scope of the investigation will determine if HOF issues will be analyzed. Senior management support is essential if the scope of the RCA is to include an analysis of HOF issues.
- RCAs which identify HOF issues may be perceived to be subjective and tend to be cross-functional affecting many parts of the organisation. There is a tendency to focus on what can be fixed easily identifying quantitative versus qualitative results. The burden of proof for HOF issues will be higher.
- The identification of organisational issues through an Apparent Cause Evaluation is unlikely.
- Many organisations fail to investigate the extent of condition or extent of cause of an event, particularly with respect to organisational issues.
- It can be difficult to identify specific, measurable and effective correct actions for HOF causes of events. This may lead to questions as to whether the RCA was correct in the first place.

Recommendations:

- Provide clear instructions and examples for investigators on how to use the available tools to identify HOF issues in the RCA process. A systematic use of the analysis tools to gather factual data will support the credibility of the conclusions reached.
- Use multiple analysis tools in an investigation involving HOF to ensure convergent validity of data to support conclusions. This will legitimize the identification of HOF issues and avoid the perception of subjective results.
- “Human error” is not a root cause but an outcome of behaviours. Organisations should not accept “human error” as a root cause but explore the organisational factors to understand why an individual may have acted as they did.
- In RCA training, use case studies where HOF issues have had significant implications in order to educate and raise awareness in the organisation (e.g. Columbia Space Shuttle, Piper Alpha etc.)
- Develop a formal trending program which integrates the results of low level event investigations, self assessment, safety culture surveys, and external reviews to build a picture of the HOF issues in the organisation.

- Conduct an extent of condition and extent of cause analysis for those events which involve HOF.
- Ensure that those with responsibility for implementing corrective actions understand the facts which support the conclusions reached by the investigation team.
- Establish a consensus of terms and their definitions within the organisation and with the regulator.

Team Composition / Learning

Barriers:

- Investigator skill in RCA methodology and HOF knowledge is necessary to identify HOF issues.
- It is an increasing challenge to develop and maintain investigator skills as fewer and fewer RCAs are done per year. The average is ~ 2-3 RCA / unit / year. This challenge is greater in small organisations.
- A lack of RCAs conducted may limit the opportunities for learning from the identification of organisational issues.
- The level of management sponsor assigned to a RCA team is important to ensure that the scope of the investigation includes a consideration of the HOF causes and that cross functional organisational units are considered.
- Measuring the effectiveness of corrective actions implemented to address HOF causes of events may take time to observe measurable improvements. In the absence of immediate and measurable improvements, the organisation may be reluctant to accept report conclusions identifying HOF causes.

Recommendations:

- Develop a RCA training qualification program with both a knowledge and skill component. Investigators should conduct 2-3 RCA investigations per year in order to maintain their competence.
- Ensure that HOF training provided for RCA investigators is conducted by an individual with HOF expertise and knowledge.
- An HOF specialist should be on the RCA team or available for consultation if the team leader does not have HOF expertise.
- There should be close collaboration between RCA analysts and HOF specialists. Specialists in these areas should be located physically close together within the organisation to facilitate relationship building.
- The organisational level of the management sponsor assigned to a RCA investigation should be commensurate with the significance of the event.
- Review corrective actions to confirm implementation and for effectiveness in addressing the root cause. The corrective actions for organisational issues may take a long time to take effect.
- Communicate the results of an RCA investigation to promote understanding of the event in the organisation and to encourage learning.

APPENDIX A: CSNI ACTIVITY PROPOSAL SHEET

Project/Activity Title	IDENTIFYING AND OVERCOMING BARRIERS TO EFFECTIVE CONSIDERATION OF HUMAN AND ORGANISATIONAL FACTORS IN EVENT ANALYSIS AND ROOT CAUSE ANALYSIS
Objective	<p>Identification of:</p> <ul style="list-style-type: none"> • barriers to analyzing and correctly identifying the human and organisational factors causes of events and; • barriers to implementing lessons learned from these analyses. • Recommendations for overcoming these barriers and thereby improving the identification of HOF causes of events and supporting the successful implementation of appropriate corrective actions.
Scope/Justification/Deliverables, expected results and users, relation to other projects	<p>Nuclear licensees need to have effective processes for learning from operating experience in order to manage safety, secure continuous improvement and defend against the potential for repeat events. These processes include root cause analysis (RCA) to identify the underlying causes of events; and arrangements to learn from these analyses and implement improvements. Correctly identifying and correcting the causes of events will allow lessons to be learned and shared with others in the industry.</p> <p>The treatment of HOF in RCA is of special interest to CSNI/WGHOF. It is estimated that approximately 60-80% of events in the nuclear industry can be attributed to Human and Organisational Factors (HOF). While the importance of correctly identifying the HOF causes is understood, there is still a tendency for RCAs to focus on the technical aspects of events, and the history of prominent events across the major hazards sector shows that the HOF lessons fail to be learned. This raises a number of questions including:</p>

	<ul style="list-style-type: none"> • Why is it that utilities are still not focusing on the identification of HOF in event analysis? • What are the barriers which prevent the adequate treatment of HOF in RCA? For example, is there a lack of knowledge/experience of HOF in root cause analysts? Is resource availability a problem? • Does the training available in RCA adequately address HOF aspects of event analysis? • Where HOF weaknesses are identified, are they difficult – perhaps even painful – for management to deal with such that corrective measures are not always implemented effectively ? <p>WGHOE has determined that there is a need for further work to address these issues. This is consistent with the conclusions of the 2006 CNRA/WGOE meeting in Cologne called for WGHOE to consider the treatment of HOF in events and RCA.</p> <p>It is proposed that WGHOE carries out a Task consisting of the following steps:</p> <ul style="list-style-type: none"> • Preparatory work to develop a set of questions on the treatment of HOF in RCA by licensee organisations. The focus of the questions will be on the identification of barriers to successful identification of HOF in RCA, and to implementation of improvements. • WGHOE members to answer the questions utilizing input from a representative sample of their licensees. Members are encouraged to utilize any means at their disposal to directly access information from the licensee on these issues. • Analysis of the information collected to identify themes for discussion. • Small working group of experts with relevant expertise to discuss identified obstacles and to make recommendations to enhance the identification of HOF in RCA. It is expected that representatives from WGOE and WANO would be invited to participate in this discussion. • The output of the small working group discussion would be a set of recommendations to address the major obstacles identified in the successful treatment of HOF in RCA.
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	Note that a survey of the various RCA methodologies used by different regulatory bodies / utilities is not proposed. WGHOE specialists agreed that many methods are suitable for RCA; the use would depend upon the specific situation. It is the way in which these methods are used, and wider organisational barriers to their effectiveness, which is of importance in this Task.
Safety significance/ priority (see priority criteria in Section IV.1)	Safety Significance: HIGH This work will benefit from being completed by an international group to share experience. The Task has been framed to achieve useful and practical outputs with limited resource in short timescales.
Safety Issue and topic covered	As this Task seeks to support improved HOF in root cause analysis and implementation of improvements it is related to CSNI Safety Issues 3: Industry initiatives to improve economics and safety performance; and 4: Necessity to ensure safety over plant lifecycle.
Milestones (deliverables vs. time)	<ul style="list-style-type: none"> • Clarification of concepts and preparation of questions: September 2008 • Presentation of questions to WGHOE members: December 2008 • Responses received from WGHOE members: February 2009 • Analysis of information and preparation of themes for discussion at ad hoc meeting: March 2009 • Small ad hoc meeting of select special experts to identify the key obstacles in the treatment of HOF in RCA. Draft a series of recommendations for the successful treatment of HOF in RCA. September 2009
Lead organisation(s) and coordination	Canada (CNSC), UK (NII), USA (NRC)
Participants (individuals and organisations)	WGHOE, in Collaboration with CNRA/WGOE and WANO, IAEA
Resources	Leading country estimated level of effort is about 8 man weeks.

	<p>Member countries estimated effort will be about 1 man week) (questions answered, formulation of country response).</p> <p>Workshop participants 1-2 days.</p>
Requested action from PRG/CSNI	Approval of proposal
PRG recommendation	Endorsement after correcting the error dealing with the leading organisations
CSNI Disposition	

APPENDIX B: SUMMARY OF QUESTIONNAIRE RESPONSES

Challenges to Identifying and Correcting Human and Organisational Factors in Root Cause Analysis

The organizing committee received 26 responses from 11 different countries.

The questionnaire was divided into two sections organised by the objectives of the original CSNI Activity Proposal Sheet.

Objective 1: Identification of Barriers to Analyzing and Identifying Human and Organisational Factors (HOF) in Root Cause Analysis (RCA)

1. Describe the process that is used to categorize events or incidents in which HOF may be relevant. Who completes the initial categorization of events? Do they have competence in HOF?

Most respondents indicated the categorization process within their organisation is formally documented and considers factors such as actual or potential safety significance, business impact and whether it is a repeat event. Most indicated that management can initiate a RCA at their discretion. The initial categorization of events is usually conducted by a cross-functional review team which includes management involvement. Some respondents indicated a review by HOF specialists but this was limited. In general, many indicated those performing the initial categorization may have little HOF training.

2. How do you determine that an event warrants a root cause analysis? Does this decision consider the potential as well as the actual impact on safety?

This is similar to question 1, with the initial categorization often indicating a RCA is required. Some mentioned RCAs may be done at management direction and in one case at the direction of the regulator. There was also mention of a preliminary assessment indicating further investigation is warranted. In essentially all cases, actual or potential safety significance is considered in the decision on whether to conduct an RCA or a lesser level of investigation.

3. When an investigation of the event is required (e.g. root cause analysis or other less formal analyses) describe the process that is followed in your organisation. Specifically:

a. What training in human and organisational factors is required of / available to investigators?

Many respondents mentioned HOF training is provided only as a component of RCA training. Many indicated that training in Human Performance aspects (e.g. Human Performance Enhancement System, HPES) is adequate but training in organisational factors is lacking.

b. Do you believe the training provided is adequate to enable you to identify the underlying organisational aspects of events?

There were a wide variety of answers ranging from a simple “yes”, to concerns that training does not adequately address this aspect. Many respondents considered this an area of weakness and many mentioned that investigator experience is necessary for identification of underlying organisational aspects of events.

c. Do root cause analysis teams always include an individual(s) with HOF training and experience?

Most respondents indicated the RCA team do not usually involve an HOF specialist, and that this is not a requirement in their process. One identified that if HOF is identified in an event, the team will be lead by an HOF-trained investigator. Two respondents (from the same country) indicated the RCA team will always include such an individual. A few respondents said that their processes required HOF specialist involvement in either the RCA team or in a post-review.

d. Do the analysis methodology / tools explicitly and adequately address HOF?

Analysis of the responses suggests that there are mixed opinions on the adequacy of the available methodology / tools to adequately address HOF issues. A common response was that the methodology / tools are not explicit in the treatment of HOF issues and therefore the tools are not typically used to their full extent. While Human Performance issues could often be determined, there was indication that organisational factors were not addressed well by the methodology/tools in use.

e. Are team members assigned full time to the RCA investigation or do they have other duties as well?

Most indicated they did not have full-time RCA investigators as there are an insufficient number of investigations to justify such a position. When assigned, most indicated that investigators worked full-time on the investigation until its completion. This was not always the case however, with some investigators still held accountable for the work in their substantive position. Some respondents described a challenge in acquiring resources for a RCA investigation due to their other priorities.

f. Are there any time restrictions for completing the RCA? Does this in any way affect the quality of the investigation?

Many respondents identified time limits or guidelines for completion of RCAs, but essentially all indicated that production of a quality RCA was an overriding concern and quality would not be compromised to meet timelines. Two respondents mentioned regulatory reporting requirements, with one indicating these could be extended if required.

g. Does the team have the authority to interview top management if necessary?

All respondents indicated the RCA team could interview top management, but several replies indicated a reluctance or concern to do so.

h. How is the scope of the RCA determined? Who is consulted in determining the scope?

Typically a formal charter or terms of reference are developed to define the scope of the investigation. The team and lead will provide input but the final scope of the investigation must be approved by management. A few respondents indicated the RCA teams had a “free hand” to investigate as they deemed appropriate.

4. Think of an investigation that successfully identified underlying HOF contributions; what made this investigation successful?

The following were mentioned in the responses:

- Engagement/support of management team, with the investigation and development of the corrective actions
- Proper use of methodology/tools
- Experienced and skilled investigators
- Presence of the required subject matter expertise on the team

5. Describe an example(s) where the root causes were not well received by senior managers. Why do you think this occurred?

Factors included:

- Lack of management support and engagement in the process
- Management were surprised by report content
- Root causes which are not well documented or supported by facts lead to the questioning of the RCA results 5HOF perceived to be more subjective°
- Reluctance of management to be self-critical

6. How easy is it to identify HOF in the RCA process? Provide examples of HOF which are easy to identify. What kinds of HOF issues are more difficult to identify?

Usually human performance issues related to individual behaviours and work place conditions are easy to identify. Factors such as individual fatigue, time pressures, skill levels, etc. can be more difficult to extract. Organisational factors are even more difficult to identify and may require subject matter expertise or senior manager experience to identify. Respondents indicated that organisational factors can be difficult to “prove”.

7. Is there a good understanding within the senior management of the organisation of the need for effective RCAs to probe human and organisational contributions?

Analysis suggests that management believe they are supportive of an effective RCA processes but there are several factors which affect the reality of this belief. As discussed earlier, any lack of understanding or knowledge on the part of managers as to the nature of a good RCA, or regarding HOF issues in general affect this negatively. Some managers also demonstrate a reluctance to dedicate already scarce resources to the investigation team if the value of the process is not understood.

8. What do you believe are the main challenges in identifying the underlying human and organisational contributions to events?

Many issues identified, including;

- Cross functional nature of HOF issues can lead to reluctance to criticize others (investigating outside the line organisation)
- Limited availability of trained and experienced investigators (e.g. managers doing RCAs)
- Maintaining the independence of those investigating the event
- Preventing management from interfering or influencing the results of the investigation
- Fear of retribution against those investigating (“shoot the messenger”)
- Unwillingness of management to be self critical
- Identification of issues which they believe they can fix and avoidance of hard to resolve issues e.g. organisational culture
- Tendency to look at quantitative rather than qualitative aspects as they are easier to measure and “prove”

Objective 2: Identification of barriers to implementing lessons learned from these analyses.**1. Describe the process that is followed within your organisation after a RCA is complete.**

Most responses indicated some management or team review of the completed RCA. Some mentioned that corrective actions are negotiated with those who will be assigned the action prior to finalization of the report. Most countries use a database to track progress and completion of the corrective actions. Several respondents indicated some type of effectiveness review of completed actions after a suitable period of time.

2. If a human/organisational issue is identified within the report, how are the appropriate corrective actions determined?

Corrective actions are based directly on the root causes and should be reviewed by the management team. Corrective actions involving HOF issues are treated similarly to other corrective actions related to non-HOF issues. Respondents indicated that corrective actions must be formulated so that they can be achieved and measured and that this is perceived to be more difficult for HOF issues.

3. Describe example(s) of a corrective action plan that adequately addressed the HOF causes identified in an investigation report. Describe the characteristics that made this example a success?

Several mentioned that the investigation was completed by a skilled and experienced RCA investigator or team. The investigation was based on factual information and so therefore the corrective action plan to address the HOF causes was clear. Discussion of the corrective actions with those who will be responsible for implementation was also mentioned as a key to success.

4. Describe example(s) of a corrective action plan which did not adequately address the human and organisational causes of the event. Why do you think HOF issues were not adequately addressed?

Several issues were identified including;

- Root causes not adequately identified therefore corrective actions may not have been appropriate,
- Those assigned corrective actions were not engaged in the process and so there was a lack of understanding of the issues or the actions were not completed
- A reluctance (or inability) of management to address the issue.

5. Describe example(s) of the implementation of a corrective action plan that went well. What are the characteristics that made this example a success?

Specific factors mentioned included

- Management engagement in the investigative process and in the development of the resulting corrective actions
- Corrective actions which were specific and measurable

6. Describe example(s) of a corrective action plan which was not well implemented? Why was it not well implemented?

Examples mentioned included:

- Lack of management support due to inadequate priority assigned, under-reaction to the seriousness of the event, incomplete actions etc.
- Implementation and effectiveness of the corrective actions was not measurable
- Reasons and importance of the corrective actions were not clear to those responsible for their implementation

7. Describe how and when the effectiveness of a corrective action plan, in addressing the original root causes of the event, may be evaluated in your organisation.

Many respondents indicated that the effectiveness of corrective actions was assessed within 6 months to 1 year after completion. Most respondents mentioned that the identification of repeat events was one measure of the effectiveness of the corrective action in addressing the original root causes. One respondent provided the specific questions that are asked as part of the effectiveness review.

8. Describe example(s) of a corrective action plan which was not evaluated for effectiveness. Why was this not done?

Most respondents indicated RCA corrective action plans are almost always completed, with only one respondent indicating this was not done for RCAs.

9. Is there visible senior management commitment to learn from events? What form does this take?

Essentially all respondents indicated senior management commitment, with specific examples of management review or oversight meetings which deal with RCA and/or Operating Experience (OPEX) reviews.

10. Does your organisation have a process to learn from events and good practices in other companies and other sectors (e.g. oil, chemical, aviation, aerospace etc)? How does this work?

All respondents indicated some review is conducted of nuclear industry OPEX (INPO, WANO, IAEA, VGB, etc.), with several mentioning benchmarking trips to other nuclear power plants. Few respondents indicated processes to learn from other than nuclear industries. Several mentioned a central group as responsible for reviewing OPEX.

11. Corrective actions relating to behaviours or organisational improvements can affect the whole company. How does senior management ensure that lessons are applied widely, not just in the area affected by the event?

Many respondents mentioned processes for sharing lessons learned or OPEX. Many indicated that although senior management is aware of the importance of sharing lessons learned these activities are not routinely conducted. Some respondents cautioned that lessons related to HOF may or may not

apply to other areas of the plant organisation or company and so care must be taken in assessing the extent of the condition.

12. What do you believe are the main challenges in implementing organisational lessons learned from RCAs?

Many factors were identified, including:

- Management support and buy-in to the RCA process
- Management support and resource commitment for the resulting corrective actions
- Adequacy of training in HOF for investigators
- Communication and awareness of HOF issues in events
- Resistance to change

APPENDIX C: SPECIAL EXPERTS MEETING ANNOUNCEMENT

**CSNI/WGHOF Specialists Meeting on
Identification of Barriers to Analyzing and Identifying Human and Organisational Factors in Root
Cause Analysis**

Paris, France, September 21 – 22, 2009

Announcement and Call for Papers

Deadline for Registration and Submission of Abstracts:	July 31, 2009
Notification of Accepted Papers:	August 14, 2009
Deadline for Submission of Full Papers:	September 4, 2009

1. ORGANISATION AND HOST

The CSNI/WGHOF Specialists Meeting on **”Identification of Barriers to Analyzing and Identifying Human and Organisational Factors in Root Cause Analysis”** will be held from 21 to 22 September 2009 in the **Nuclear Energy Agency Headquarters, Room B, 12 Boulevard des Îles, 92130 Issy-les-Moulineaux, France**. The Specialists Meeting is planned for two days. This announcement is to inform you of this event and to issue a call for papers to be submitted for presentation at the Specialists Meeting.

2. OBJECTIVES OF THE SPECIALISTS MEETING

The objective of this Specialists Meeting is identification of:

- barriers to analyzing and correctly identifying the Human and Organisational Factors (HOF) causes of events;
- barriers to implementing lessons learned from these analyses; and
- recommendations for overcoming these barriers to
 - improve the identification of HOF causes of events and
 - support the successful implementation of appropriate corrective actions.

3. BACKGROUND OF THE SPECIALISTS MEETING

Nuclear licensees need to have effective processes for learning from operating experience in order to manage safety, secure continuous improvement and defend against the potential for repeat events. These processes include root cause analysis (RCA) to identify the underlying causes of events; and arrangements to learn from these analyses and implement improvements. Correctly identifying and correcting the causes of events will allow lessons to be learned and shared with others in the industry.

The treatment of HOF in RCA is of special interest to CSNI/WGHOF (Working Group on Human and Organisational Factors). It is estimated that approximately 60-80% of events in the nuclear industry can be attributed to human and organisational factors. Although the importance of correctly identifying the HOF causes is understood, there is still a tendency for RCAs to focus on the technical aspects of events, and the history of prominent events across the major hazards sector shows that the HOF lessons fail to be learned. This raises a number of questions including:

- What are the factors that impede utilities in focusing on the identification of HOF in event analysis?
- What are the barriers which prevent the adequate treatment of HOF in RCA? For example, is there a lack of knowledge/experience of HOF in root cause analysts? Is resource availability a problem?
- Does the training available in RCA adequately address HOF aspects of event analysis?
- Where HOF weaknesses are identified, are they difficult – perhaps even painful – for management to deal with such that corrective measures are not always implemented effectively?

WGHOF has determined that there is a need for further work to address these issues. This is consistent with the conclusions of the 2006 CNRA/WGOE (Working Group on Operating Experience) meeting in Cologne, which called for WGHOF to consider the treatment of HOF in events and RCA.

4. SCOPE, CONTENT AND OUTLINE OF THE SPECIALISTS MEETING

The Specialists Meeting will include an introductory session where the results of a questionnaire that was disseminated to licensees, practitioners and regulators on this topic will be presented. There will be a number of short presentations relevant to the objectives of the Specialists Meeting by participating specialists. Small groups will discuss and identify barriers to the effective treatment of HOF in RCA and to implementing lessons learned from these analyses. This will include themes identified through an analysis of the questionnaire responses including:

- Role and influence of senior management;
- Skills and knowledge of the investigators;
- Qualitative nature of HOF
- Influence of the regulator;
- Systematic approaches to investigations.

The final session will summarize the discussions and develop conclusions and recommendations for overcoming the barriers to the effective treatment of HOF in RCA. Further CSNI actions will also be identified.

5. LOGISTICS AND PARTICIPATION IN THE SPECIALISTS MEETING

Participants

The intention of the Specialists Meeting organisers is that experts with practical experience in RCA representing different levels of licensee staff, some regulators and international organisations such as IAEA and EU should participate in the event.

Those wishing to make a presentation at the Specialist Meeting should submit an abstract with their preliminary registration form.

The number of participants to the Specialists Meeting is limited to 20 persons, so if a situation developed where there were too many nominations, the Steering Committee reserves the right to select participants based on their potential contribution to the meeting.

Registration

Participants should complete the attached registration form (Appendix 1) and send it by **July 31, 2009** to the NEA Secretariat and Steering Committee (see contact addresses further).

There is no registration fee.

Location and accommodation

The Specialists Meeting will be organised by the OECD/NEA and held in the **NEA Headquarters, 12 Boulevard des Îles, 92130 Issy-les-Moulineaux, France.**

You can find more details about the Specialists Meeting place, hotels nearby here <http://www.nea.fr/html/general/welcome.html>.

Language

All presentations and discussions will be in English, and good command of the English language will be useful to fully benefit from the Specialists Meeting.

Papers

Participants wishing to present papers shall submit an abstract (between 200 and 400 words). All abstracts should be submitted by **July 31, 2009**. Please complete the attached registration form (Appendix 1) and send it to the NEA Secretariat and Steering Committee. (Note: All submitted abstracts and papers should be submitted electronically in MS Word and "times 11" font.) Abstracts should demonstrate direct relevance to the objectives of the Specialists Meeting.

The Steering Committee will review abstracts, and authors will be notified by **August 14, 2009**. Specific instructions for the format of papers will be provided to authors. Full papers should be submitted by **September 4, 2009**.

Presentations of the papers should not exceed 20 minutes and should be sent not later than **15 September 2009**.

Specialists meeting proceedings

Proceedings from the Specialist Meeting will be published, and will include results of the questionnaires, presentations, conclusions and recommendations from the discussion groups, and information papers submitted by participants to the Specialists Meeting.

Steering Committee

The Steering Committee organised the sessions and the final program for the Specialists Meeting. The following persons form the Steering Committee of the meeting:

Ms. Suzanne JACKSON	CNSC	Canada	Chair
Mr. Dennis McCool	CNSC	Canada	
Dr. Valerie Barnes	USNRC	US	
Mr. Radomir REHACEK	OECD-NEA	International	Secretariat

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CSNI/WGHOF Specialists Meeting on

Identification of Barriers to Analyzing and Identifying Human and Organisational Factors in Root Cause Analysis

Paris, France, September 21 – 22, 2009

Registration / Abstract Form

Surname (Family Name) ¹:

Given Name (s):

Title or Function:

Institution, Organisation or
Company (full address):

Telephone No. :

Telefax No. :

E-mail address:

Title of the paper (abstract to
be added, if any):

Form to be completed as soon as possible and no later than **31, July 2009**.

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¹ (Please indicate whether Prof., Dr., Mr., Ms., Miss.)

APPENDIX D: MEETING AGENDA

Identification of Barriers to Analyzing and Identifying Human and Organisational Factors in Root Cause Analysis

The meeting will be held at the Nuclear Energy Agency Headquarters (**7th floor**), Room B, 12 Boulevard des Iles, 92130 Issy-les-Moulineaux, France.

Monday September 21, 2009

9:00 – 9:50 am	Introductions Overview of Project Framework for Root Cause Analysis Survey Results
9:50 – 10:10 am	Paper – Dr. Atoosa Thunem <i>Culture as a Fundament for Considering or Neglecting the Role of Organisational Factors in Root Causes of Events</i>
10:10 – 10:30 am	Break
10:30 – 12:15 pm	Small group discussion #1
12:15 – 1:30 pm	Lunch
1:30 – 2:30 pm	Small group reports from discussion #1
2:30 – 2:50 pm	Paper – Kay Wilde Gallogly <i>Using a Systematic Approach to Identifying Organisational Factors in Root Cause Analysis</i>
2:50 – 3:10 pm	Break
3:10 – 5:10 pm	Small group discussion #2
5:10 – 5:20 pm	Reconvene Discuss dinner plans

Tuesday September 22, 2009

9:00 – 10:00 am	Small group reports from discussion #2
10:00 – 10:20 am	Paper – Dr. Petri Koistinen <i>Doing HOF work in NPP – An Internal Specialist Point of View</i>
10:20 – 10:40 am	Break
10:40 – 11:00 am	Paper – Dr. Ryuji Kubota <i>Japanese Situations to Emerging Themes</i>
11:00 – 12:45 pm	Small group discussion #3
12:45 – 2:00 pm	Lunch
2:00 – 3:00 pm	Small group reports from discussion #3
3:00 – 3:30 pm	Break
3:30 – 4:30 pm	Consolidated Findings / Discussion Next steps

APPENDIX E: LIST OF PARTICIPANTS

OECD/NEA Specialists Meeting
Identification of Barriers to Analyzing and Identifying Human and Organisational Factors in Root Cause Analysis
21-22 September 2009
NEA Headquarters, Issy-les-Moulineaux, France

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APPENDIX F: SMALL GROUP PRESENTATIONS FOR EACH SESSION

Discussion Group
Group 1
Discussion # 1
Senior Management /
Organizational Issues

**Do Senior Managers understand
the RCA process?**

- Senior versus lower level management
- Not typically trained in RCA
- know its important
- RCA as integral part of safety culture development
- Cost/benefit concern
- Independent review of RCAs before senior manager sign
- Visible support (quality oversight, supervise review committees, worker interaction, etc.)

Who in the organization is responsible for RCA?

- Investigation by line organization, with help from expert group (e.g. Safety, QA org) and sometimes HOF expert
- For big events, may be independent of the line organization
- Review by mgmt group before finalized
- Final report signed by Plant head

Are there regulatory requirements / influence

- RCAs rejected from regulator (in some cases)
- RCA preliminary results needed to allow plant restart after an event
- Reports to regulator receive more scrutiny
(is this good?)
- When reports go to regulator, some factors may be downplayed
- Independent regulatory response may result (separate from RCA)

Does the culture of the organization affect the RCA process?

- May limit the depth
- Time pressure, short term actions/results
- React to behavior vs the cause
- RCA results can drive org culture change
- Supplier/contractor- RCA dilution (may be difficult to find RC, different standards/practices, etc.)

Specific Recommendations

- Checklist for managers for RCA review
- Training catered for to management level (RCA, oversight, OPEX process, how does RCA/CA fit in/contribute to safety culture, etc.)
- Senior managers have to be seen to value RCA through specific actions;
 - Plant oversight/RCA review committees
 - Presentation of events to industry groups
 - Interactions with plant personnel (on-going)

Discussion Group

Group # 2

Discussion # 1

Senior Management /
Organizational Issues

Do SM understand the RCA
process?

- Maybe, for the process
- Maybe, for the support for finding OF's
- Sometimes No, for the CA's

Who in the organization is responsible for RCA?

- Line, senior management or sometimes an independent organization (like QA, ops. safety) may start the investigation
- RCA are conducted by independent actors, line supports
- Approval of RCA by those who have authority to conduct CA's

Are there regulatory requirements / influence

- USA: yes and it influences, NPP's must conduct RCA for significant events, also guideline, NRC requires also SC issues, RCA process is reviewed every 2 years
- Finland: yes, but no guideline
- Czech: yes, inspection of investigations of RCA's is done regulator
- France: elaborated by EDF and regulator can require RCA and no guidelines for analysis
- Sweden: like Czech

Does the culture of the organization affect the RCA process?

- DEFINETELY!
- Maturity of organization and (senior) management is required
- Just or fair culture
 - Events are moments of truth in this sense

Not so learning supporting culture...



Specific Recommendations

- RCA's has to be organized in way to ensure their quality
 - Independence
 - Enough power to conduct RCA
- Senior management support is required
 - must have a clear understanding on RCA's



Discussion Group

Group 3

Discussion # 1

Senior Management /
Organizational Issues

Do SM understand the RCA process?

- OF are understood in a limited, simple and practical way
- Lack of understanding what is behind a RCA.
- SM know the value of the RCA.
- SM are afraid of the consequences of such analysis, like Media.
- SM focused too much in organizational structured and not enough in Subcultures or elements.

Who in the organization is responsible for RCA?

- Should not be seen as “internal affairs”.
- Avoid to perform RCA with one of the subcultures of the organization (reflex the biases of the position in the organization)
- People from outside the organization.
- Focus groups
- SM should be involved: approval of the RCA

Are there regulatory requirements / influence

- There are positive and negative influences:
 - Promotion is good
 - To be involved or approval can be wrong
- The discussion between regulator and licensee is good

Does the culture of the organization affect the RCA process?

- Yes.
- Avoid the blame or defensive culture.
- A constructive culture is needed

Specific Recommendations

- To keep the RCA inside the company.
Proprietary information.
- Multidisciplinary team with/or representation from outside.
- Approval of the RCA by the SM
- The regulator should not be too prescriptive in the action to solve the organizational problems
- Move to more constructive organization (OCI)

Discussion Group # 1 Discussion # 2

Systematic Methodology / Tools

What are the challenges in using available analyses tools for identification of HOF in RCA?

- ECF, but you need to know where it might lead in order to ask the right questions
- Broad open questions to capture all information
- Current methods need supplementary analysis to uncover HOF
- Focus on known weaknesses, via requiring specific questions to be answered
- Methodology model must be open to HOF issues

How do you "handle" the perceived qualitative/subjective nature of HOF?

- Use of expertise to develop capability inside the organization, helps to develop recognition of HOFs as legitimate
- Obtain facts to support analysis, conclusions
- Review of HOF via analysis of many events, self-assessment process
- Causes of low level events analyzed versus what found in large events
- Case studies to identify HOF causes (e.g. Columbia), INSAG 18 examples

Is the vocabulary used in RCA methodologies consistent?

- Sometimes very specific language used by HOF specialists, not always easily understood by line investigators
- Categorizations can lead to consistent language (group reviews, RCA writers consider categorizations)

Will organizational issues be identified in analyses less intensive than RCA?

- Not likely – not trended
- Dependent on investigator knowledge if these get identified

Are you able to identify organizational issues from a single event?

- Yes you can...(for large events)
- Straw that broke the camel's back
- If not substantiated, at least can be identified/flagged

Are you able to identify organizational issues from a single event?

Is it difficult to make a clear link between RCA and CAs?

What do you do if your scope expands?

Recommendations

- Expand the model to be more inclusive of HOF considerations
- Keep broad perspective (open mind)
- Good examples/case studies to educate
- Have RCA writers consider the categorization in their report
- Independent review of categorizations (by HOF experts, management teams?)

- France – ECF + others + internal cause factor/categorization codes
- RF –ASSET-based, HOF if indicated, IAEA Tecdoc comparison
- Japan – JHPES, primary focus HP in past, now improving HOF analysis
- Belgium - WANO – ECF + others, categorized
- UK – primary barrier + WANO categorization

Discussion Group # 2 Discussion # 2

Systematic Methodology / Tools

What are the challenges in using available analyses tools for identification of HOF in RCA?

- Tools:
 - Czech – HPES
 - France – Factor Tree Barrier Analysis
 - USA – MORT, TapRoot, etc and Barrier, Change, Task Analysis and Event and Causal Factor Charting
 - Finland – Case by case - social science case work
 - Sweden – MTO (Modified HPES)
- Challenges:
 - People not trained – non specialists – 2 day course
 - Time and resources
 - Small number conducted – not enough opportunities to become proficient
 - Language
 - Training vs. proficiency – simple training exercises in the classroom
 - Other jobs – important of task
 - Ability to understand what is behind – what is inside
 - Support
 - Competency of the interviewers

Cont.

- Methods:
 - Use the method that is typical for the event that you have
 - Not one universal method for everything
 - MORT (?) TapRoot (?)
 - Know to ask the questions that lead you there

How do you "handle" the perceived qualitative/subjective nature of HOF?

- Ability to generate factual information
 - How well do you know the organization – large amount of data – know what to look for
 - Contractor
 - A lot more than interviews – documents – technical logs
 - Validation / verification
 - The systematic use of the tools
- Ability of the tools
 - Competency of the investigators
 - The systematic use of the tools

Is the vocabulary used in RCA methodologies consistent?

- No
 - Definitions
 - Understanding of the terms
 - Created by experts and used by non-experts
 - Too academic
- Difficulties
 - Trending
 - Regulator review
 - Beginning have a common understanding between licensee and the regulator
 - Introduced by experts and then the regulator and licensee have to make a common use of them (their own)

Will organizational issues be identified in analyses less intensive than RCA?

- Depending on the analysis
- The skill of the analyst
- In reading the frequent events can identify organizational issues
- It depends...
- Start with the question – Is HOF involved? Most times it is. Is it relevant? What can be learned from it?

Are you able to identify organizational issues from a single event?

- YES and
- NO
 - Under estimated
 - Difficult to see the root cause
- Does it make sense to go there – how deep do you want to go

Is an extent of condition / extent of cause analysis always done?

- Almost always done with equipment but not always with HOF.
- Don't see explicitly in LER
- Depends on what system is affected
- An attempt to do but not understood so it is not done well
- Understanding what you are analyzing
- Will do if there are multiple events – frequency – what is a similar event?

Is it difficult to make a clear link between RCA and CAs?

- Finding the right corrective action
 - Depends on the root cause – simple / easy – not so simple / more difficult
 - Gap between the investigators and the people responsible for implementing the corrective action
 - Based on facts
 - Ask the people involved what they would do
 - Bring the people involved together to determine the corrective actions
 - Resources can impact the 'right' corrective action

What do you do if your scope expands?

- Just do it
- Go back to your manager
- Expand to include the new scope
- Go back to see if you missed something else – is the expansion more than what you think
- Ignore it
- Start a new investigation – time – too big to handle

Recommendations

- Training – Who would be the one to train?
- Define HOF
- Cooperate more with other branches and countries
- Use the right method for the right event – not a big hammer when you have a small nail
- Use the tools right – (takes an expert to know when to deviate.)
- Cross functional meeting when formulating corrective actions
- Send a draft of the facts to all of the people involved to verify the information
- Openness of root cause analysis within the company – so that they have input – not a police investigation
- Validation and verification of the inputs

Recommendation

- Clear definitions with examples to reduce mismatches
- Have a policy of having a scope in the assignment
- Have a policy of how to handle an increase in scope
- Have an established deadline

Discussion Group # 3 Discussion # 2

Systematic Methodology / Tools

What are the challenges in using available analyses tools for identification of HOF in RCA?

- Defining the problem, the scope of RCA (how many events and how deep the analysis)
- Perceived time
- Knowledge about systems and processes governing the organization
- Knowledge about using the tools correctly

How do you "handle" the perceived qualitative/subjective nature of HOF?

- Applying historical knowledge about the events (happened in the past) in a more deep manner
- Using "factual factors" as much as possible, although this may mean that no thorough analysis can be done for one particular event
- Many tools available are satisfactory, but they are used in different ways, and therefore not always in a desired way

Is the vocabulary used in RCA methodologies consistent?

- Definitely not (examples: reliability, safety analysis, human performance)
- Methodologies do use the same term but with different meanings
- However, there are local consistency (within the plant)
-

Will organizational issues be identified in analyses less intensive than RCA?

- It depends on the purpose and nature of the analysis. Many organizational factors can be identified through self-assessment analysis, analyses related to change management.
- It depends also on defining human and organization issues, the expertise of the analysts (the observations made by the HOF specialists)

Are you able to identify organizational issues from a single event?

- It depends on the event : If it is complex or “simple” enough, root causes of organizational nature can also be revealed.
- Given that the issues can be identified through one single event, the issues are usually of limited scope (example: clarification of roles/responsibilities, training instructions, etc)
- One single event can also act as a path finder for identifying similar events

Is an extent of the condition/ extent of the cause analysis always done?

- No. This analysis is not always done, particularly for organizational factors.
- Without facts and evident, it might be difficult to do the analysis

Is it difficult to make a clear link between RCA and CAs?

- Usually, it is difficult to establish this link, although it might be achievable.
- Also, the links might not be one-to-one, but one-to-many or many-to-one.
- Finally, some expressed CAs can actually lead to the identification of some root causes that have not been described.

What do you do if your scope expands?

- PANIC!!!

Recommendations

- Clear instructions on how to use the tools
- Ensure SMEs are a part of the team doing
- Trying to establish a consensus on terms and their definitions inside the organization
- Ensuring that the “outsiders” familiarize themselves with the terms and their definitions

Discussion Group # 1 Discussion # 3

Team Composition / Attributes

What are the challenges associated in team
/ individual competence?

- Subject matter experts (SME) needed (depending on event)
- Team includes persons involved in the event (in many cases), with HOF expert consultant as required
- Leader needs management experience (implies knowledge/training of HOF)

Is there management / HOF representation on the team?

- If HOF expertise it is obtained

Does the level of the management sponsor affect the willingness of the organization to accept the HOF in RCA?

- Yes
(willingness of management to see reality)

Are RCA results presented to management? Who presents?

- Often presented to management team before finalized (allows challenges)
- In some cases, report seen only after completed
- Some cases of plant manager presenting to peers

Recommendations

- Ideally experienced managers lead investigations
- Different approaches based on advantages/disadvantages to team composition
- Results to be presented to management team for challenges (mostly already done)

Discussion # 3

Learning

How many RCAs are done in a year? Is this sufficient?

- France – 5-10 events/units (2-3 very deep)
- UK – 3 - 4/year over 4 facilities (fuel/labs)
- Japan – 1-2 /licensee (5-6 units) – sent to regulator (10 reports for ~50 units)
- Belgium - ~25/unit (5 reports by teams)
- Canada – 3/unit/year
- Advantages/disadvantages between expertise of using line org. people (infrequently) vs non-line org. experts

Could you identify organizational issues using an “Apparent Cause Analysis” method?

- Already done yesterday

Are events with HOF issues trended in your organization?

- Yes (but need HOF identified in lower level events and this is a challenge)

How do you know you have a learning organization?

- If not then
 - Poor corrective action completion
 - Actions predominately towards training/procedure
 - Repeat events
 - Little feedback on investigation report results to plant staff
- Attributes
 - Timeliness of information provided to others (OPEX shared)
 - OPEX evaluated/used
 - TSMS, benchmarking
 - Safety seminars/meetings
 - Self-reporting of deficiencies (near misses?)
 - Periodic comparison to standards (e.g. OSART)

How can you measure the effectiveness of CAs?

- Repeat events
- Question/probe/observe completion
- Impact on performance (safety indicators, specific process performance indicators)
- Checked possibly by other processes (audit, self assessment)
- May be reflected in trends of low level events

- Some checks done to see if the organization is learning, via self-assessment, audits, etc.

Discussion Group # 2 Discussion # 3

Team Composition / Attributes

What are the challenges associated in team / individual competence?

- Independent investigation
- Line organization should be involved in the event to provide data
- The line organization should 'own' the investigation
- Technical differences in the knowledge of the team – mixed team members
- Skilled interviewers, someone who knows the process, and a HOF specialist
- Process for the whole RCA process
 - How to select the people
 - What should be investigated
 - Etc. Etc. Etc.
- Requirement for the team leader on the qualifications
- Requirement to stay competent by completing a number of investigations a year.

Is there management / HOF representation on the team?

- No but has to be a sponsor from top management
- Management must be involved and informed
- NO so that the investigators can speak freely

Does the level of the management sponsor affect the willingness of the organization to accept the HOF in RCA?

- YES
- Otherwise there is no one to support the CAs
- In IRSN it will be accepted without the sponsorship – it depends on the nature of the event for EDF
- Providing resources and guaranteeing access to relevant information
-

Are RCA results presented to management? Who presents?

- Presented to Management:
 - Yes
- Who:
 - The team lead
 - Manager of Operating Experience
 - Director of the line organization who owns the event
 - There are different forums which determines who presents

Recommendations

- RCA needs top management support
- Having a policy to covers the RCA process
- Mixed team members
- Independency and psychological safety so that taking part in an investigation will not harm their career. Will not harm them in any way for participating in the investigation.
- Team composition – that HOF expertise is required
- Competency – two ways from formal training and experience
- Personal attributes – what does a good investigator look like
 - Curious
 - Tenacious – doesn't give up
 - Trust building
 - Credible
 - Emotional and social intelligence
 - Good oral and writing communication skills



Discussion # 3

Learning

How many RCAs are done in a year? Is this sufficient?

- Done in a year
 - TVO – 2 -3 per unit
 - France – 20 – 30 (800 total)
 - Czech – 40 – 50
 - Sweden – 2- 4 per unit
 - USA – varies by station general 5 – 50
- Sufficient in terms of sustaining the proficiency?
 - Depends if the same person does the investigation (Leading investigator and HOF needs to do 2 to 3 per year to stay proficient)
- Sufficient to identify organizational issues?
 - Yes if done correctly – depends on other processes (operating experience, self assessments, ect.)

Could you identify organizational issues using an “Apparent Cause Analysis” method?

- Answered with Discussion 2 yesterday.
- YES and
- NO

Are events with HOF issues trended in your organization?

- Finland – Not on RCA’s but on lower level events.
- Sweden – Yes
- France – Yes
- Czech – Yes
- USA - Yes

What do you do with the trends?

- Sweden – in the inspection program for the next year or taken care of immediately if significant – regular meetings with the NPPs.
- France – in the inspection program – report to the regulator, and sometimes specific meetings with the managers of EDF and the ASN, regular meetings with the EDF and the IRSN – two levels of meetings (NPPs and headquarters)
- Finland – Included in various inspections and regular meeting with the regulator – regulator also trends
- Czech – meeting with regulator and about the human factor prepare for the next year activities for the Operations personnel – changes in the simulator training
- USA – varies – annual or quarterly trend reports, management team review meetings, and common cause investigations

How do you know you have a learning organization?

- Regulator input

How can you measure the effectiveness of CAs?

- Hard for the NPP's to do
- Important to do
- Not enough to look at repeat events
- Need to have a plan
- Evaluate case by case
- Completed after there has been a challenge to the action
- Six months may not be enough time to ensure effectiveness – one hour may be enough in some cases
- Assessment for EDF but also sometimes there are inspections – specific studies by IRSN.

Recommendations

- Investigator Lead and HOF needs to complete 2- 3 investigations per year to maintain competency.
- Number of investigations required to maintain competency should be in the company policy.
- A training policy including proficiency trials

Discussion Group # 3 Discussion # 3

Team Composition / Attributes

What are the challenges associated in team / individual competence?

- The analyst is an expert in RCA (methodology expert) ... an expert who understands the spirit of it and live up to it
- He needs to be able to identify the other required expert domains (set up an ad-hoc team)
- “Right” mind-set, openness,... voluntary for the job
- Soft skill when interfacing with others in the plant (interview, choosing the right words in the reports...)
- Cross-disciplines communication

Is there management / HOF representation on the team?

- Management representation :
 - Mostly at the end of the analysis
- HOF :
 - Spain : Always... when there is an 'obvious' HOF dimension
 - FR : not systematic.. Depends on the sites

Does the level of the management sponsor affect the willingness of the organization to accept the HOF in RCA?

- Definitely!
- The quality of the analysis is central... CAs should be realistic.

Are RCA results presented to management? Who presents?

- Yes... but there are differences...
- The lead HOF group is doing the presentation (or briefing the sponsor... depending on the level of reporting)
- Presentation of events might be more systematic than presentation of RCA results

Recommendations

- Close collaboration between HOF expert and RCA analysts (they should sit together)
- Management should not be involved in the data gathering phase
- Line managers involved in analysis
- SM involved in defining CAs
- Cost of CAs should be considered
- Beware of the words used during the briefings (eg 'human error' explanation)

Discussion # 3

Learning

How many RCAs are done in a year? Is this sufficient?

- Spain, France : 10-12 per year / facility
- Sufficient to sustain skills and expertise... but is it sufficient for OL ?
- Results from these analyses should be consolidated with other sources of data (self-assessments, SC surveys...)

Could you identify organizational issues using an “Apparent Cause Analysis” method?

- Through the use of statistics... but further investigation might be needed to understand the org. issue ‘flagged’... (data might not be perfect, but numbers bring ‘truth’)

Are events with HOF issues trended in your organization?

- Spain : yes
- France : not systematically but working toward that goal!

How do you know you have a learning organization?

- It should be demonstrated every day...
- Possible criteria (necessary, but not sufficient)
 - Depth of analyses
 - Systems to identify and keep the knowledge
 - Systems to use the knowledge
 - Use of the knowledge (do I read the books I have in my library ?) - Indications that I live up to that knowledge

How can you measure the effectiveness of CAs?

- You need time...
- A trending program should be in place
- Spain :
 - Internal and/or external reviews of improvement programs (HOF and SC)
 - WANO peer reviews
- Implementation of CA does not necessarily mean that the CA is effective nor that the root-cause disappears

Recommendations

- Trend identification does not necessarily need to be based on perfect analyses !
- HOF trend identification can be proceduralised (to support the HOF specialist)
- Check the effectiveness of the CAs !!!!!
(easy to say...)

APPENDIX G: PRESENTATIONS AND PAPERS

Dr. AtoosaThunem

The Role of Organizational Factors in Event Reporting and Incident investigation

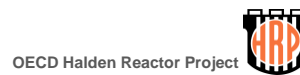
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Outline

- Introduction
- The role of organizational factors in events and incidents
- Reference to organizational factors in event reporting and incident investigation activities
- General organization science: Fundamental perspectives and theories
- Safety-oriented theories involving organizational factors
- Fundamental issues to be aware of, before attempting to apply the theories



The role of organizational factors in events and incidents

- Studies and practical experiences indicate that OFs do play a significant role in the course of events and incidents (root causes, immediate causes, Event, barriers, consequences, corrective and recovery actions)
- A majority of the OFs involved in the course of events are culture-driven, although hidden within structure-driven OFs.
- OFs are in many cases the root cause for human- or technology-oriented deficiencies (errors, mistakes, faults and failures)
- OFs constitute in many cases the most efficient yet difficult-to-implement measures for eliminating root causes and limiting the impact of consequences of events



Reference to OFs in event reporting and incident investigation activities

- OFs are in the great majority of activities completely ignored
- Many references to human factors as causes of events reveal in fact the central role of OFs, that hereby are presented as HFs (blaming-the-individuals culture)
- In those few concluding reports addressing OFs among causes, only structure-related factors (e.g. roles and procedures) are mentioned and presented as “root causes”. Real and culture-related root causes are not considered.



General organization science: Fundamental perspectives and theories

- Four phases in Organization theories' development:
 - Pre-historic: “The surrounding is irrelevant”
 - modernistic: Clear separation between the organization and its surroundings with objective relationship
 - symbolic: “There is no clear separation and the relationship is defined by both the individuals and the collective”
 - post-modernistic: Discovering hidden motives behind the expressed opinions and interpretations → The role of culture
- Most well-known theories in each phase: Institutional, stakeholder, Bounded rationality, agent, contingency
- Emerging theories from post-modernistic era:
 - Drucker: Appreciating the customer and the knowledge worker
 - Bolman & Deal: Four different organization models
 - Weick: Open organizations, HRO, mindfulness for improved safety
 - Schein: Viewing cultural factors at different abstraction levels



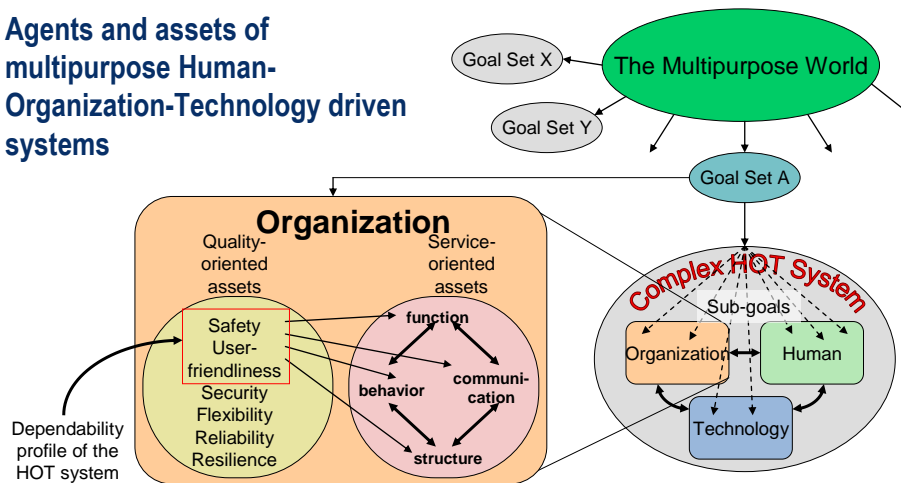
Safety-oriented theories involving organizational factors

- Existing *methods* have very limited focus on organizational factors
- Those dealing with organizational factors do that with one dependability aspect in focus: Safety
- Therefore, the factors are not systematically categorized
- The term “reliability” has a very specific definition, as opposed to its linguistic derivations
- Furthermore, the definition has been “hijacked” by some within the “probabilistic” community!
- “New” approaches and methods are thus suggested based on certain presumptions



Fundamental issues to be aware of, before attempting to apply the theories (1)

Agents and assets of multipurpose Human-Organization-Technology driven systems



Fundamental issues to be aware of, before attempting to apply the theories (2)

- Confusing theories with methods
- “Follow-the-crowd” trend
- Different meaning and interpretation of the same term from different disciplines and schools: Can lead to fundamental misunderstanding, if the term is crucial within one of the disciplines
 - Criticizing the HRO theory by some within the PSA community
- Focus on quantitative analysis before any solid qualitative results have been made available → resulting in too many assumptions and thus distancing from the real world



Culture as a Fundament for Considering or Neglecting the Role of Organisational Factors in Root Causes
of Events

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Abstract

This paper is particularly about the role of organisational factors in root causes of events. Furthermore, the paper claims that the great majority of barriers to analyzing and identifying human and organisational factors during root cause analysis have themselves their origin in organisational (and culture-based) root causes. In that regard, the paper discusses some established theories and approaches that in one way or another have scrutinized culture-driven organisational factors. The paper addresses also some experiences from particularly nuclear and petroleum domains.

Key Words: Organisation science and theories, culture, Organisational factors, root cause analysis

Introduction

Although everyone agrees that systems these days are no longer associated with purely technical factors but indeed are true Human-Organisation-Technology (HOT)² driven systems, practical experiences indicate that much focus during incident investigations is still on technical factors and in limited degree on human factors related to the entire event life-line, including the root causes.

Studying the role of organisational factors is often ignored. Also, many root cause analyses reveal that a sizable fraction of contributing organisational factors is hidden as a consequence of rephrasing the factors and presenting them as human factors. Forming phrases such as “the operator didn’t have the adequate training to handle many alarms on the control panel” and presenting them as root causes is common in incident investigations within various domains. At the same time, despite the fact that numerous approaches have been developed by scientists and practitioners to deal with different types of human and organisational aspects of HOT systems, the established trend in many communities studying these aspects still seems to be that the focus of the studies is driven by the discipline that forms the scientific education of the environment’s majority.

For instance, if the majority of the environment’s Research & Development resources have a background within mathematics or statistics, they might focus particularly on structural factors such as roles and responsibilities, competence, skill, training, and adequate steering documents when analyzing organisational factors. Similarly, if the resources are mostly industrial psychologists, they might tend to view the structural factors mentioned with specific attention towards human performance.

Anthropologists may, on the other hand, focus more on how certain norms of behavior and communication at different levels (including the management) in an organisation can lead people to omit following procedures. As incident investigations rely on the R&D results, a more interdisciplinary effort on producing those results is believed to help investigators, so that they become more aware of analyzing and identifying human and organisational factors.

² A synonymous term still widely used within the nuclear community is “Man, Technology, Organization”, or “MTO”.

The purpose of this paper is specifically to draw the attention towards the role of organisational factors in root causes of events. The authors claim that the great majority of barriers to analyzing and identifying human and organisational factors during root cause analysis have themselves their origin in organisational root causes. They also claim that these causes are primarily of a cultural nature. To demonstrate this, the paper discusses some established theories and approaches that in one way or another have scrutinized culture-driven organisational factors, while it also refers to practical experiences related to event reporting and incident investigation³ from especially nuclear and petroleum domains.

Organisation science and theories⁴

The great influence of scientific disciplines such as sociology, psychology, anthropology, philosophy and informatics (i.e., computer science/information and communication sciences) on organisation science and theory is evident. From these, however, branches are formed that can be regarded as most influential, especially during the 20th century. The three most attracting among scientists and practitioners seem to be industrial and organisational psychology, industrial and organisational sociology, and human factors [1]. Although the three branches are the manifestation of different schools of thought, they are indeed related and cannot be discussed separately from one another. This explains also why one cannot pinpoint “best” among existing approaches and methods developed within or across the branches.

Organisational Factors in Safety Research

When it comes to event and incident investigations, it is especially since the 80’s (where the researchers seriously began to analyze the contributions of human and organisational factors to the incidents) that a number of human- and organisation-oriented approaches in the context of safety have been developed.

However, as organisational factors in safety research are viewed in relation to safety and not to each other, e.g., through focus on other dependability aspects, the factors addressed in the approaches that have emerged specifically from safety research and that are usually applied in event and incident investigations are not categorized nor systematically discussed. Furthermore, although some approaches, such as High Reliability Organisation theory [2], touch the matter in some degree, addressing culture-related organisational factors has generally been very limited in established approaches.

Organisational Factors in Organisation Research

As far as general organisation research is concerned, however, there is a considerable amount of work on cultural aspects. The following explains briefly four of the approaches.

Organisation management with focus on customer and knowledge worker: One of the most influential works within organisation management is that of Peter F. Drucker [4]. Drucker’s particular stress on customer needs contributed to the introduction of the concept of *learning organisation* [5]. It is with this focus that Drucker introduces the term “knowledge worker”. Through his recommendations to treat knowledge workers as an investment and not as a cost, Drucker is a supporter of a management culture, where employers see the organisation from the employees’ perspective and gain understanding of their

³ In this paper, “event reporting” refers to the activity the “owner” of the event (the organization responsible for the event) has carried out, whereas “incident investigation” refers to the activity usually performed by a third party, e.g., an inspectorate body. The involving factors in the event/incident life-line that are covered by these two groups of activities in terms of their concluding documents (assumed available) for a specific event/incident, are not necessary identical.

⁴ This chapter is a compressed representation of a part of [3].

sense of reality and opinions. Drucker addresses in this connection a number of aspects such as competence development and alliance between values, and argues that the way to deal with these factors depends on the established culture in an organisation, but also on the organisation's potential (the willingness and ability) to change an established culture.

Organisation analysis and modeling: While Drucker pays more attention to what organisation management should look like, the joint work of Lee G. Bolman and Terrence E. Deal [6] deals more with different models of organisations that currently exist. Bolman and Deal define four groups, or four perspectives: The structural, the human resource, the political and the symbolic perspectives. The perspectives are also relevant with regard to planning and implementation of changes.

In the structural perspective, the organisation is purposeful, determined and rational. It has also a formal and hierarchical structure. The formality can be seen in the quantity and scope of written policies and procedures, and the hierarchy exists both related to information flow and the degree of influence. Task distribution is carried out by taking into account individual competence and experience, rather than individual needs and interests.

Supervision and control is regarded necessary for ensuring the preservation of the formal structure. In the human resource perspective, the organisation is the framework for partnership between managers and employees, because they need each other. Managers need the employees' knowledge, skill and different types of competence, and the employees need the managers to ensure salary, career opportunity and job security. When the needs of both groups are covered, both will benefit from it. In contrast to the structural perspective, the political perspective describes organisations almost as chaotic establishments.

Organisations are coalitions of individuals and interest groups with different values, beliefs, information, interests, priorities and perceptions of reality, which often are enduring. The most important decisions in organisations involve the allocation and distribution of resources that are already scarce. Permanent differences between groups and lack of resources create bases for conflict, where especially possessing power and exercising it will assume a central role. The symbolic perspective blends in with the human resource perspective, but it is unique in the sense that it builds on social anthropology.

Organisations therefore work in the same way as the tribes and small societal communities, where the organisation is driven by stories, myths, spiritual ceremonies and rituals, metaphors, humor, games, and hero worship. In organisations that follow the symbolic perspective, it is not important to ascertain what happens during an event, but rather what is the meaning behind the event and how it is described. Therefore, the same event and process can have different meanings and interpretations. Uncertainties and ambiguities are handled by creating symbols to make them appear reduced or removed.

Robust organizing and open organisations: The idea of robust and reliable organisations was at the beginning advocated by very few scientists. Today, many derivations, where some claimed to be "new", exist from the original approach. Among the most profound proponents of the approach is Karl Weick [2], who has also introduced the term *loose coupling*, originally defined and used in informatics, in modern organisation studies. According to Weick, open organisations are those that through mutual independence and thus through robust relationships internally and externally can manage large amounts of almost unmanageable information. Establishment of independence between the organisation's constituents and between the organisation and the surroundings requires development of *organisational learning culture*.

He uses the term *enactment* to emphasize that the actors in the organisation determine and enact the surroundings by responding to their own social construction of the surroundings. A consequence of this is that organisations themselves establish the information basis the members use to determine and evaluate themselves and the surroundings. Communicating the organisation's properties internally and externally can therefore both have an affirmative and a blinding effect, because the communication can lead to the organisation's increased focus on living up to its image, or it may cause deviations, failures and deficiencies related to the organisation's various properties, and indicating that the organisation does not live up to its image, to become hidden under this image.

Through his theory, and specifically through the introduction of the concept of *mindfulness* [7] in safety research literature, Weick has also contributed directly to the establishment of the High Reliability organisation viewpoint and the concept of *safety culture*.

Categorization of cultural factors and culture-focused change management: More systematic focus on the role of culture began by, among others, the introduction of the term *corporate culture* by Edgar Schein [8] and his categorization of cultural factors at three different levels of abstraction, each level providing a certain perception about the manifestation of the cultural factors.

The *artifacts and behavior level* is at the top of the organisational culture with regard to visibility. Artifacts and behaviors can be seen, felt and heard. They may be the organisation's physical facilities, offices, formation of offices (individual versus landscape offices), furnishings, visible awards and honors, the employees' way of attire (e.g., formal or informal), the way the employees greet each other, communicate with each other or with visitors. The *espoused values level* describes the organisation's stated and written philosophy, vision, goals and strategy, which will be communicated and expressed through the entire organisation.

They are also used as a basis to produce formal procedures and guidelines for different types of tasks and roles. Finally, the *basic underlying assumptions level* describes the deepest aspects of the organisation's culture, difficult to pinpoint, understand and describe, yet learned and known by the majority of the organisation's members. The assumptions are *invisible* elements of the established culture of the organisation, which cannot be identified cognitively by organisation's employees.

They may include unwritten rules for etiquette, for other types of behavior and communication, for practical handling of formal procedures and guidelines, for marketing, etc. They can also include habits for certain types of reality perception, for thought processes, for actions, for emotional expressions, and for use of metaphors, symbols and rituals. Finally, they can include elements of culture that are subject to taboo and not discussed.

Schein argues that basic and underlying assumptions may act as defense mechanisms against the introduction of changes in an organisation. He also believes that these assumptions cannot be detected, understood and described through, e.g., investigations and random interviews, but only through in-depth analysis means that may also explain the mutual relationship between the three levels, hence revealing what is the substance of various cultural factors and how these factors manifest themselves and are expressed.

Practical experiences related to event reporting and incident investigations

Based on concrete experiences particularly within nuclear and petroleum domains, the authors' observation is that there is a legible and growing declaration of focus on especially human factors. Although many events with evident influence from human and organisational factors are still reported as almost entirely caused by technical factors [9], it is also the authors' observation that many event reports and incident investigations not only declare to, but also actually *do* focus on the role of the human factors, as causes of, and as fences/barriers against, event and incident progress.

It is, however, also a significant observation that organisational factors are very often neglected when dealing with description and analysis of the event life-line. Furthermore, in many reports, most organisational factors are in fact represented as human factors, hence hidden. As an example, insufficient competence and experience is often represented as a cause related to the individual(s) involved in an incident, and not related to the organisation the individuals are a part of. The organisation is implicitly regarded as "not involved".

In those event reports and incident investigations that do cover organisational factors, causes related to those factors are mostly identified as unclear definition and allocation of roles and responsibilities, poor

procedures and work processes, and insufficient safety and risk analysis. Such causes are additionally defined as “root causes”. This means that the underlying factors explaining why roles were defined unclearly, why procedures were poor and why safety and risk analysis was insufficient, are never dealt with. It is the author’s belief that this itself implies that many of such factors ought to be organisation-related, and furthermore, that they are of cultural characteristic, and therefore deep-rooted.

The authors have also reason to believe that the great majority of barriers to analysis, identification and description of organisational factors during root cause analysis have themselves their origin in those organisational root causes of cultural nature. As an example, thorough analysis of event reports and incident investigations has revealed application of organisation models that do not harmonize with the true organisation in which the event or incident has taken place.

In other words, there is a detectable reluctance among reporters and investigators to probe deeper when it comes to defining and identifying the real root causes of a cultural nature, and it is possible that such reluctance itself can be explained in terms of a certain culture. This culture could be, e.g., that in the role of an analyst or investigator, one has tendency to work based on a structural perspective of the organisation wherein the event or accident has happened, while the organisation in focus actually does not fit into the model the analysis/investigation is based upon.

It is important to point out the crucial role of the event analyst or incident investigator to actually consider culture-oriented aspects related to all stages of the event course, from the event back to its immediate and underlying causes as well as broken barriers in the course towards the actual event, and from there to more broken barriers and thus actual consequences of the event.

The significance of an interdisciplinary effort to deal with culture-oriented organisational factors is also important to bear in mind, as these factors are by nature complex, capable of manifesting themselves both as barriers against a holistic root cause analysis, as root causes to events and as barriers against undesirable progress of events towards serious consequences. Therefore, it is believed that also more concrete and explicit research is necessary, so that one better can make visible both means and obstacles for explicit identification and description of organisational factors in event reporting and incident investigations.

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Kay Gallogly

Using a Systematic Approach to Identifying Organizational Factors in Root Cause Analysis

**CSNI/WGHOF Specialists Meeting on
Identification of Barriers to Analyzing
and Identifying Human and
Organizational Factors in Root Cause
Analysis
Paris, France, September 21 – 22, 2009
Kay Wilde Gallogly**

Goal

- A collegial discussion



Outline

- Current Situation
- Definition of HOF
- Systematic Use of Analysis Tools



Current Situation

- Analysts do not recognize the HOF elements of the event as such
- Analysts do not have the words to articulate the HOF
- Analysts do not see the connection between the analysis tools and the identification of the HOF.
 - Not used to analyze the event
 - Created after the fact for presentation purposes only
 - Created after the fact as a function of checking it off the requirements list
- Thus there is not a systematic approach




Defining HOF

- **In theory**
 - Human Performance
 - Organizational and Programmatic Factors
- **In practice**
 - Active vs Latent condition
 - The Circle of Influence / Concern for the O&P
 - The Circle of Influence / Concern for the HU



Definition in Theory

- **Human Performance Factors**
 - “**Human errors** are inappropriate or inadequate human actions, including failures to take action when required.”
 - “A phrase that generally means the slips and mistakes of humankind.”
 - “**Human Factor (as applied to systems)**. The area concerned with the application of knowledge about human capabilities and limitations with respect to the design of systems and environments and the selection, training, and management of staff to achieve optimum interaction between staff and systems in terms of system efficiency and safety (7). Also, any attributes to characterize human activities for functioning technological systems (12).”



Human Performance Factors Defined, Cont.

- “**Human factors** is a body of scientific facts about human characteristics. The term covers all biomedical, psychological, and psychosocial considerations; it includes, but is not limited to, principles and applications in the areas of human factors engineering, personnel selection, training, job performance aids, and human performance evaluation.”
- “The study of how human beings function within various work environments as they interact with equipment in the performance of various roles and tasks (at the human-machine interface):
- U.S. meaning: ergonomics, human engineering using definition 1) and sometimes human performance
- European meaning: human performance usually including training and human resources”



Human Performance Factors Defined, also

- “A **human performance problem** is a term used to collectively refer to human errors and human performance trends.”
- “Human-system Interface (HSI) is defined as the technology through which personnel interact with systems, e.g. alarms, displays, controls, procedures, valve handles, test points.”

Definition in Theory

- **Organizational and Programmatic Factors**
 - “**Latent Condition** - The undetected conditions created by latent errors; that is, organizational weaknesses, flawed defenses, or error precursors. (see also latent organizational weaknesses)”
 - “**Latent Organizational Weakness** - Undetected deficiencies in processes or values that create work-place conditions that either provoke error or degrade the integrity of defenses. (see also Anatomy of an Event and latent error)”
 - “A **programmatic cause** is a deficiency in one of the licensee's policies, programs and processes for managing work activities at a site that allows human errors to occur. For example, a deficiency in a licensee's training program could set the stage for errors because workers may not have the knowledge or required skills to perform a job correctly.”

Additional Guidance

- **NRC Inspection Manual Inspection Procedure 95001 and 95002**
 - “A determination of cause and effect relationships resulting in an identification of root and contributory causes which consider potential hardware, process, and human performance issues.
 - For example:
 - hardware issues could include design, materials, systems aging, and environmental conditions;
 - process issues could include procedures, work practices, operational policies, supervision and oversight, preventive and corrective maintenance programs, and quality control methods; and
 - human performance issues could include training, communications, human system interface, and fitness for duty.”



Definitions in Practice

- Possible:
 - Active Error
 - Latent condition

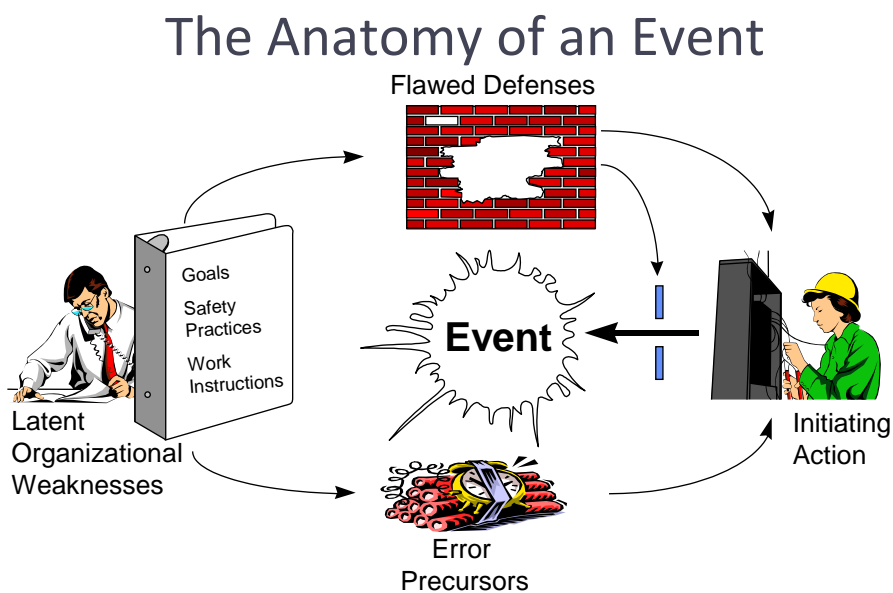


Human Performance Factors

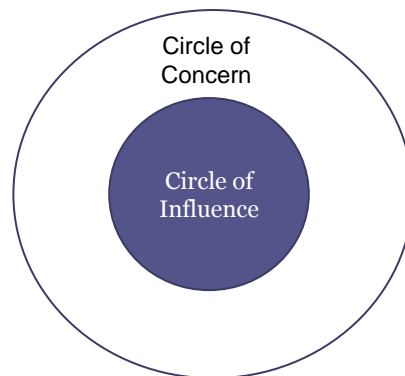
- The active error
 - The specific behaviors that were involved with the active error.

Organizational and Programmatic Factors

- The latent condition
 - The conditions that surrounded the active error.



Circle of Concern / Circle of Influence



The Systematic Approach

- **Through Analysis Tools:**
 - TWIN
 - Event and Causal Factor Charting
 - Barrier Analysis
 - Change Analysis
 - Task Analysis
 - HPES

TWIN / Error Precursors

Task Demands

- 1 Time Pressure
- 2 High workload
- 3 Simultaneous, Multiple tasks
- 4 Repetitive actions/monotony
- 5 Irrecoverable Actions
- 6 Interpretation Requirements
- 7 Unclear goals, roles, or responsibilities
- 8 Lack of/unclear standards

Work Environment

- 1 Distractions/interruptions
- 2 Changes/departure from routine
- 3 Confusing displays/controls
- 4 Work around/OOS instrumentation
- 5 Hidden system response
- 6 Unexpected equipment conditions
- 7 Lack of alternate indication
- 8 Personality conflicts

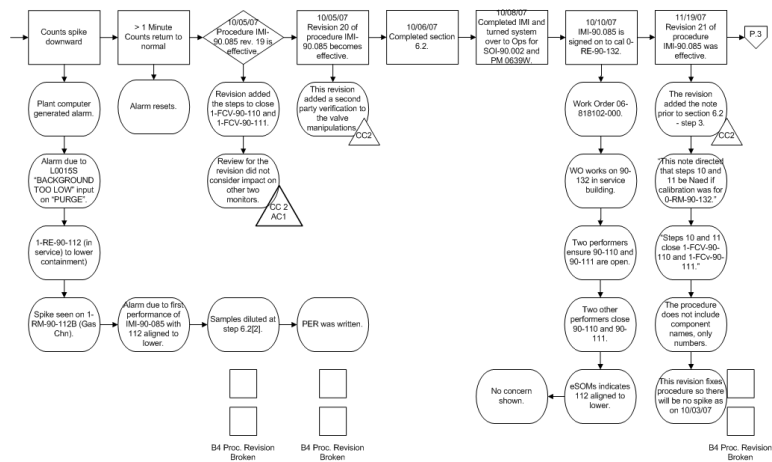
Individual Capabilities

- 1 Unfamiliar with task/first time
- 2 Lack of knowledge
- 3 New technique not used before
- 4 Imprecise communication habits
- 5 Lack of proficiency/inexperience
- 6 Indistinct problem solving skills
- 7 Can do attitude for crucial task
- 8 Illness or fatigue

Human Nature

- 1 Stress
- 2 Habit patterns
- 3 Assumptions
- 4 Complacent/overconfidence
- 5 Mind set (intentions)
- 6 Inaccurate risk perception
- 7 Mental shortcuts (biases)
- 8 Limited short term memory

Event and Causal Factor Charting



Barrier Analysis

FAILED OR INEFFECTIVE BARRIER	HOW BARRIER FAILED	WHY BARRIER FAILED	CORRECTIVE ACTION TO RESTORE BARRIER TO EFFECTIVENESS
Procedure Revision Process		HOF	
Writer		HOF	
Peer review		HOF	
Management reviewer		HOF	
Authority sign off		HOF	
Computer Platform		HOF	

Successful Performance:
 Unsuccessful Performance:

Change Analysis

Successful Performance:
 Unsuccessful Performance:

Factors That Influence Performance	Successful Performance	Failed Performance	Change?	Causal Factor?
Who?		HOF		HOF
What?		HOF		HOF
When?		HOF		HOF
Where?		HOF		HOF
How?		HOF		HOF

Task Analysis

Task Steps	Desired Action	Actual Behavior	Difference	Causal Factor
Step 3.5		HOF		HOF
Step 3.6		HOF		HOF
Step 3.7		HOF		HOF
Step 3.8		HOF		HOF
Step 3.9		HOF		HOF

HPES

- Verbal Communication
 - Communication Types
 - Face-to-face
 - Intended Function
 - Pre-job Briefing
 - What was the communication cause
 - Pertinent Information not transmitted
 - Entry point into the Why Staircase
 - *Words to articulate the cause(s)*



Conclusion

- Definitions
- Differentiating between Human and Organizational Factors
- Use of analysis tools as designed for event analysis not just presentation



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Using a Systematic Approach to Identifying Organisational Factors in Root Cause Analysis

Kay Wilde Gallogly – The 42 Group, LLC

Current Situation

There are multiple barriers that exist that prevent event investigation analysts from correctly identifying the human and organisational factors that exist in an event. A number of the barriers have been identified in the survey. Barriers that exist may be for the individual analyst or more broad based within the organisation. Experience indicates that having analysis tools that provide a systematic factually based methodology to analyze the gathered data assists in the identification of the human and organisational factors. The use of the systematic factually based analysis tools not only assists in the factor identification but also in better articulation of the issues to achieve a greater understanding and acceptance by the approving authority and management review group.

Use of a Systematic Approach

The standard analysis tools of Event and Causal Factor Charting, Barrier Analysis, Change Analysis, and Task Analysis are typically used but not always to the degree that result in the identification of the human and organisational factors. The Anatomy of an Event model is also conducive to a systematic and factually based review of the event. Turning to experience, most analysts use the tools in a cursory manner and thus do not derive the full analysis possibilities leading to the identification of the human and organisational factors. This experience shows that in most cases the analyst will stop short of the deeper learning that leads to effective problem resolution.

In part this may be the result of the philosophical approach that is adopted at the particular facility. The philosophy is carried out in both the investigation approach and execution and in the management review. The philosophy dictates methodology and depth, including the degree of the systematic approach.

The traditional analysis tools of Event and Causal Factor Charting, Barrier Analysis, Change Analysis, and Task Analysis were designed originally to follow a specific methodology. In some cases this methodology has been stream lined under the perception of efficiency to meet the time constraints of the investigation and facility philosophy. An example is to have investigation documents that are brief rather than comprehensive. The facility philosophy also comes into play in the accepted practices in how the tools are used, in that a particular analysis tool is used for presentation rather than analysis. This is frequently the case with an Event and Causal Factor Chart.

Recognition of the Human Performance and the Organisational Elements

In the review of root cause analysis reports and in conducting training, there is an indication that human and organisational aspects have been considered. In some cases the analyst did not recognize them as such and the factors were not highlighted as such. There are also instances where the focus has solely been on the equipment factors in great detail with no regard to understanding maintenance practices, procedure approach, preventive maintenance attitudes, and schedule adherence. In essence, not considering the human and organisational aspects of the event.

Articulating Human and Organisational Elements

As indicated in the survey responses, in some cases the analysts did not include the human and organisational aspects in the written document because of management possible negative response or lack of support. This does not mean that the investigation did not uncover the elements; it was a function of the openness of the management team to hear the findings. Key factors in management openness are that the human and organisational elements are factually and logically laid out in the investigation document and that they are articulated in words that best describe the actual situation.

All too often the root cause statements regarding the organisational factors are stated such that it is difficult to understand the actual organisation and management behaviors that got were a part of the event. An example being: 'Management does not understand what good looks like'. In using words that better describe who 'management' is and what are the specific behaviors that led to the acceptance, in this case, of less than adequate documents, will support a clear understanding of the issue. This also reduces the finger pointing.

The Human Performance Evaluation System, (HPES), if used as it is designed provides words and factor statements that can be used to articulate the behaviors and elements in play in the event. Reducing confusion or nebulous causes that are difficult to correct.

Understanding the Value of the Analysis Tools in Identifying the Human and Organisational Factors

As noted before, all too often analysis tools are not used as they are designed. This is a function of the analyst or the facility philosophy not seeing the value of the tool in the identification of the human and organisational elements of the event. In some cases there is evidence that the analysis tools were created after the investigation was complete and the report was written. In this case the tools serve as presentation mechanisms.

Experience has shown that this occurs frequently in the case of Event and Causal Factor Charting. The tools were not used in the investigation itself to support data gathering or the investigation analysis but become a one sheet presentation device for the management. Some facilities have developed norms around the Event and Cause Factor Chart that dictate color, number of pages and such. The focus here is on the presentation device as opposed to a tool that is started at the beginning of the investigation to guide the systematic process.

In this present day many procedures contain the expectation that one or more analysis tools be used to support the investigation. In some cases there may be a checklist or quality review that has a check for the 'use of analysis tools'. It is not uncommon to see that an analysis tool is mentioned as being used in the investigation report but there is no factual evidence in the body of the document as to the results of the analysis that was completed. Again, it is not uncommon to see that a check has been made on the check list that analysis tools were used with no attachment or results to indicate that an analysis tool was actually used.

Though there are analysis tools that exist and are expected in the guiding procedures, they are often not used as they are designed to analyze the event. This then reduces or eliminates the systematic approach of the event investigation, subsequently the logical layout of the human and organisational factors and clear articulation of the causes.

Defining Human Performance and Organisational Factors

In understanding the barriers to using a systematic approach in the identification of human and organisational factors it was found that the definitions of human performance and organisational factors are vague. In many cases examples are used to identify what human performance factors are and what are programmatic and organisational. Interviews indicate that in many cases, the analyst has considered the factors in the investigation, though they have not recognized them as such. In better understanding this barrier, even if analysis tools are systematically used, the analysis is not clear on what the factors are under the headings of organisational and programmatic aspects. The analyst may not see that the factors were considered and thus included in the event.

A review of available documents found that in theory human and organisational factors are defined as:

Human Performance

1. **“Human errors** are inappropriate or inadequate human actions, including failures to take action when required.”

NUREG/CR-6751, The Human Performance Evaluation Process: A Resource for Reviewing the Identification and Resolution of Human Performance Problems Manuscript: Prepared by, Valerie Barnes and Brian Haagensen, contributing author: John O’Hara. NRC Project Managers; Isabelle Schoenfeld and Eugene Trager. Prepared for: Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC, NRC Job Code W6528; September 2001

“A phrase that generally means the slips and mistakes of humankind.”

Institute of Nuclear Power Operations, “Definitions of Common Human Performance Terms and Phrases”, Human Performance Fundamentals Course Reference.

2. **“Human Factor (as applied to systems).** The area concerned with the application of knowledge about human capabilities and limitations with respect to the design of systems and environments and the selection, training, and management of staff to achieve optimum interaction between staff and systems in terms of system efficiency and safety (7). Also, any attributes to characterize human activities for functioning technological systems (12).”

IAEA - Review of methodologies for analysis of safety incidents at NPPs. Final report of a co-ordinated research project 1998–2001

3. **“Human factors** is a body of scientific facts about human characteristics. The term covers all biomedical, psychological, and psychosocial considerations; it includes, but is not limited to, principles and applications in the areas of human factors engineering, personnel selection, training, job performance aids, and human performance evaluation.”

- NUREG/CR-6751, The Human Performance Evaluation Process: A Resource for Reviewing the Identification and Resolution of Human Performance Problems Manuscript: Prepared by, Valerie Barnes and Brian Haagensen, contributing author: John O’Hara. NRC Project Managers; Isabelle Schoenfeld and Eugene Trager. Prepared for: Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC, NRC Job Code W6528; September 2001

“The study of how human beings function within various work environments as they interact with equipment in the performance of various roles and tasks (at the human-machine interface):

- U.S. meaning: ergonomics, human engineering using definition 1) and sometimes human performance
- European meaning: human performance usually including training and human resources”

- Institute of Nuclear Power Operations, “Definitions of Common Human Performance Terms and Phrases”, Human Performance Fundamentals Course Reference.

4. “A **human performance problem** is a term used to collectively refer to human errors and human performance trends.”
 - NUREG/CR-6751, The Human Performance Evaluation Process: A Resource for Reviewing the Identification and Resolution of Human Performance Problems Manuscript: Prepared by, Valerie Barnes and Brian Haagensen, contributing author: John O’Hara. NRC Project Managers; Isabelle Schoenfeld and Eugene Trager. Prepared for: Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC, NRC Job Code W6528; September 2001

Nuclear Regulatory Commission, (NRC), Inspection Procedure 71841, Human Performance, (Issue date 12/12/00) does have a definition for Human-system Interface (HSI). The procedure states that:

“Human-system Interface (HSI) is defined as the technology through which personnel interact with systems, e.g. alarms, displays, controls, procedures, valve handles, test points.”

The procedure then provides a list of “Topic Areas and Causal Factors”. The list includes Human – System Interface, Environment, Communication, Work Coordination / Supervision, Work Practices, Procedure Use/Adherence, Training and Qualifications, and Fitness For Duty. Under the topic of Human – System Interface, subtopics of; visual information/display, control function/control device, and alarm / annunciation are included. In each case a list of ‘causes’ is provided. The causes included; lack of questioning attitude, walkdowns less than adequate (LTA), alarm procedure availability, and many others. The list is similar to those seen in the TapRoot™, Performance Improvement International, and MORT methodologies as well as other guiding documents provided by the IAEA, WANO, and INPO.

Organisational Factors

1. “**Latent Condition** - The undetected conditions created by latent errors; that is, organisational weaknesses, flawed defenses, or error precursors. (see also latent organisational weaknesses)”
 - Institute of Nuclear Power Operations, “Definitions of Common Human Performance Terms and Phrases”, Human Performance Fundamentals Course Reference.
2. “**Latent Organisational Weakness** - Undetected deficiencies in processes or values that create work-place conditions that either provoke error or degrade the integrity of defenses. (see also Anatomy of an Event and latent error)”
 - Institute of Nuclear Power Operations, “Definitions of Common Human Performance Terms and Phrases”, Human Performance Fundamentals Course Reference.
3. “A **programmatic cause** is a deficiency in one of the licensee's policies, programs and processes for managing work activities at a site that allows human errors to occur. For example, a deficiency in a licensee's training program could set the stage for errors because workers may not have the knowledge or required skills to perform a job correctly.”
 - NUREG/CR-6751, The Human Performance Evaluation Process: A Resource for Reviewing the Identification and Resolution of Human Performance Problems Manuscript: Prepared by, Valerie Barnes and Brian Haagensen, contributing author: John O’Hara. NRC Project Managers; Isabelle

Schoenfeld and Eugene Trager. Prepared for: Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC, NRC Job Code W6528; September 2001

A review of NRC Inspection Procedure 95001, Inspection for One or Two White Inputs in a Strategic Performance Area, (Issue date 10/16/06) and Inspection Procedure 95002, Inspection for One Degraded Cornerstone or Any Three White Inputs in a Strategic Performance Area, (Issue date 10/16/06) both provide the following guidance in Section 03.02 of each procedure for investigations:

“A determination of cause and effect relationships resulting in an identification of root and contributory causes which consider potential hardware, process, and human performance issues.

For example:

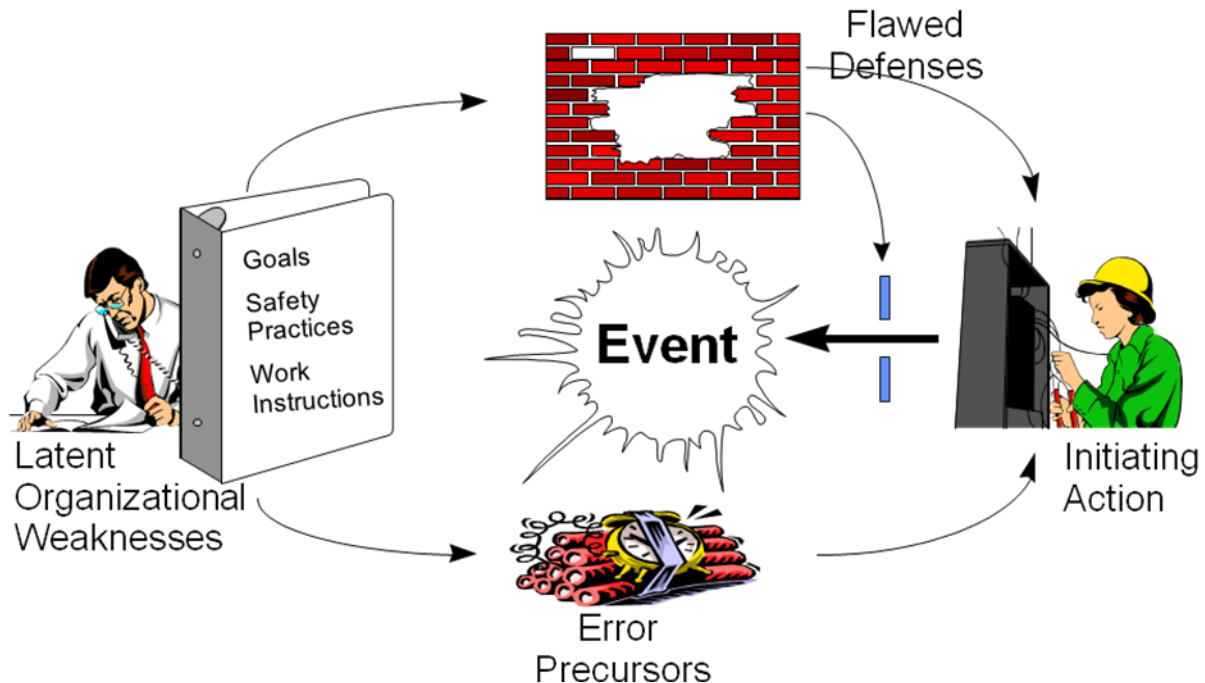
- hardware issues could include design, materials, systems aging, and environmental conditions;
- process issues could include procedures, work practices, operational policies, supervision and oversight, preventive and corrective maintenance programs, and quality control methods; and
- human performance issues could include training, communications, human system interface, and fitness for duty.”

NRC Inspection Procedure 95003 focuses on the key attributes which included human performance. No specific definitions of delineation of human performance and the organisational aspects. In one instance there is a discussion under the heading of human performance regarding clear roles and responsibilities. There are two levels that can be touched on regarding clear roles and responsibilities. In the context of the individual, clear roles and responsibilities can be in understanding the role and responsibilities in performing a surveillance test. It can also be viewed from a programmatic standpoint in that the management team has clearly outlined the role of the individual and the larger responsibilities for the individual within the group.

The point here is in what does this actually mean for the analyst? The analyst is now responsible for not only identifying but sufficiently correcting the human and organisational factors. The definitions provide some theory and example but what does this mean in practice?

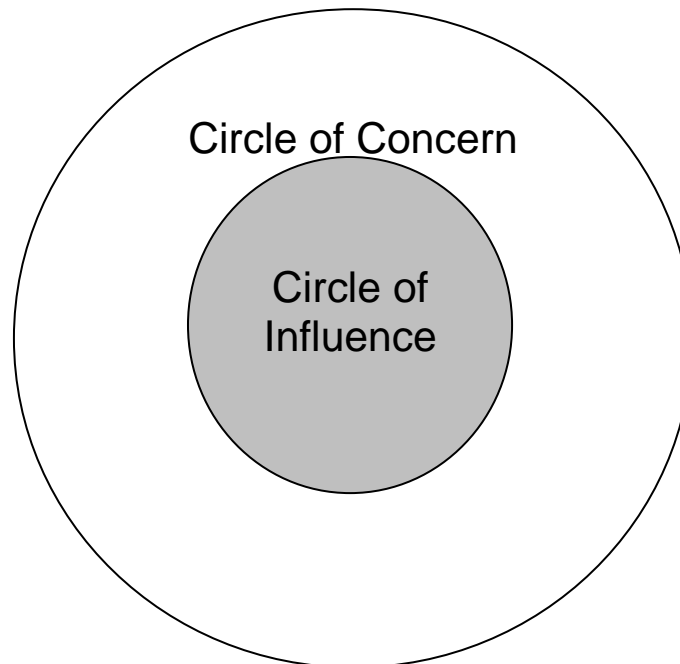
A possible way to differentiate the human from the organisational factors would be to consider at what point in the event the condition occurred. This would be the consideration of an active error versus a latent condition. This can be seen as being depicted in the model of the Anatomy of an Event as shown below.

The Anatomy of an Event



The proposed concept is that the behaviors that contributed to the action performed by the individual in the active error as shown here in the initiating event would fall under the heading of a human factor. The other elements that come into play in an event as shown in the model as Flawed Defenses, Latent Organisational Weaknesses, and Error Precursors would then fall into the consideration of the organisational and programmatic factors.

Another way of thinking of the differentiation between the human factors and the organisational factors would be in where the control of a particular factor resides. One way of considering this can be modeled using Stephen R. Covey's Circle of Concern / Circle of Influence. (This model was introduced in Stephen R. Covey's, *The 7 Habits of Highly Effective People*, Simon and Schuster, New York, New York, 1989.) The model is of two circles that show that there are some factors which fall into the control of the individual and others that fall into the concern of the organisation and subsequently into the programs and processes. This can be shown as follows:



The concept is that, though there are many concerns that individuals and organisations encounter on a daily basis, there are some factors that fall in the circle of concern and others that can be directly influenced. An example being that the management team, at least in theory, is concerned about the individual performance in the plant but they do not have direct control over the individual at the point that a button is pushed or a valve is manipulated. They can support the individual by providing the proper tools, environment, and standards. However, the individual at the panel is working under their own circle of influence. They directly influence the behavior as carried out in their action.

In the Circle of Concern / Circle of Influence for the individual there are a different set of factors. In their circle of concern they will probably include family, job security, and possibly the larger picture of overall facility performance regarding safe operation. In their circle of influence are the factors of how error reduction tools are personally used, personal standards of performance, focus, and job satisfaction.

This fits in the context of this paper as the event investigation analyst, considers what factors fall into the category of human rather than organisational and programmatic. A review of what factors are in each circle of concern and circle of influence can be helpful.

Systematic Use of Analysis Tools

There are several standard analysis tools that have been adopted by the nuclear industry to support event investigations. The standard tools are Event and Causal Factor Charting, Barrier Analysis, Change Analysis, and Task Analysis. In addition, the TWIN model is an excellent tool to assess the error precursor, flawed defenses, and latent conditions that were factors in the event. HPES also offers a methodical approach to analyzing an event that considers the human and organisational factors.

TWIN / Error Precursors

It is important to note that the use of only factual information while systematically stepping through the analysis tools is critical to maintain credibility in the investigation and the event report. It can be easy at times to gather data and complete the analysis with information that is judgmental or subjective. This information can over shadow the factual information that is used.

Recently, the TWIN model has become a part of a quick human performance analysis. This analysis is used in many facilities to determine if there were human performance factors that caused the event. The quick human performance analysis is typically started within a few hours of the event. If used systematically as designed it easily points to the organisational factors that were present as well as the individual contributor factors. The TWIN model can also be used in a complete investigation following the use of the Event and Causal Factor Chart, Barrier Analysis, Change Analysis, and Task Analysis.

In following with the above discussion, a part of the analysis using this tool would be to first look at each of the conditions that are shown in the model and determine whether or not they were a factor in the event being analyzed. It is important to note that the conditions in the model are prompts for thinking and that there may be others that are not shown that may be applicable. A trap that many analysts fall into is to think of the event in such broad terms that they find each condition in the model as being a part of the event.

The second step in using this analysis tool systematically is to consider what is in the control of the individual, what is in their circle of concern and what is in their circle of influence. This is followed by a consideration of which of the selected precursors were in the circle of influence for the organisation and facility processes.

Below is an example of the differentiation of the human and organisational factors. Using the concept of the circles of concern and the circles of influence both the human and the organisational factor can be found on what would typically appear to be a human performance focused tool. Though precursors have been highlighted to show human, organisational, or both as factors in this example, it may be that they are different in a specific event.

Human Factor Organisational Combination

Task Demands (HPT)

1. Time Pressure
2. High workload
3. Simultaneous, Multiple tasks
4. Repetitive actions/monotony
5. Irrecoverable Actions
6. Interpretation Requirements
7. Unclear goals, roles, or responsibilities
8. 8 Lack of/unclear standards

Work Environment (HPW)

- 1 Distractions/interruptions
- 2 Changes/departure from routine
- 3 Confusing displays/controls
- 4 Work around/OOS instrumentation
- 5 Hidden system response
- 6 Unexpected equipment conditions
- 7 Lack of alternate indication
- 8 Personality conflicts

Individual Capabilities (HPI)

1. Unfamiliar with task/first time
2. Lack of knowledge
3. New technique not used before
4. Imprecise communication habits
5. Lack of proficiency/inexperience
6. Indistinct problem solving skills
7. Can do attitude for crucial task
8. Illness or fatigue

Human Nature (HPH)

- 1 Stress
- 2 Habit patterns
- 3 Assumptions
- 4 Complacent/overconfidence
- 5 Mind set (intentions)
- 6 Inaccurate risk perception
- 7 Mental shortcuts (biases)
- 8 Limited short term memory

Event and Causal Factor Charting (E&CF)

The E&CF chart can be a powerful tool in determining human and organisational factors. If used as designed as an analysis tool, specific factors can be factually determined.

A first step in building an E&CF is to lay out the event actions on the action or time line. Many times the analyst will group many actions or activities into one box on the action line. This results in missed opportunities to understand the more subtle behaviors that were involved in the event. An example would be, that instead of the work was performed, to map out how the work was performed. The review of the actual behaviors in performing the work offers the greater learning as to the existence of precursors and flawed defenses.

Another potential missed opportunity for learning is in the starting point of the event. The missed opportunity for identifying human and organisational factors arises when the analysis in the E&CF is started at the time of the incident. In starting at this point, the factors that were a part of what led up to the event are missed. An example, of this is when the action line begins at the time the rigging broke rather than at the start of the work request process for the task that requires the rigging. In starting before the actual incident under investigation the environment in which the event occurred can be better understood.

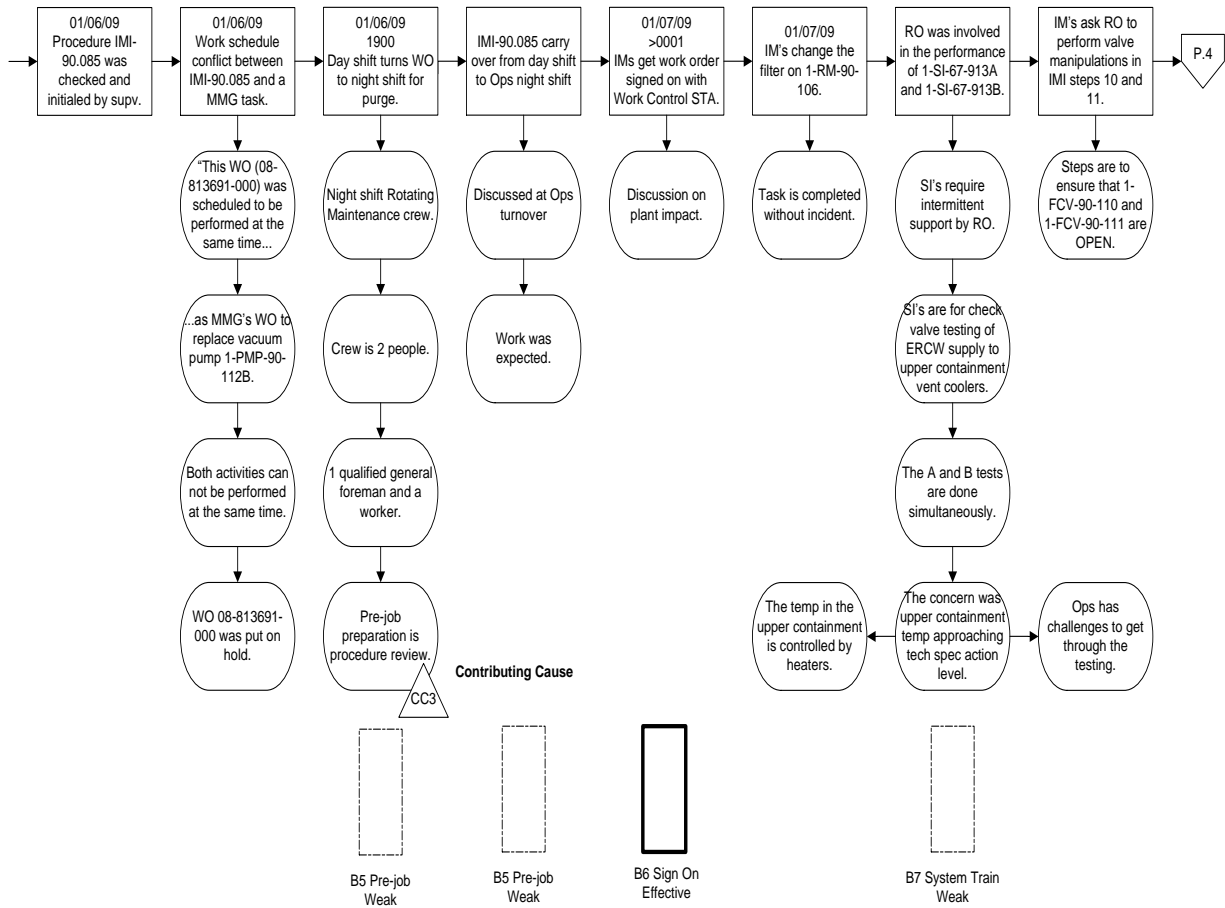
The human and organisational factors are further defined as the E&CF analysis analyzes the conditions that contributed to the action. When considering the specific action or behavior on the action line, in essence asking why the action occurred as it did, assists in identifying the human and organisational factors.

A page of an E&CF chart is shown below. This is an example of one approach to building an E&CF chart. There are other approaches but the point is that in looking at the more specific individual actions that the human and organisational factors can be identified. In this example, the E&CF was started at the last performance of the surveillance test for this particular radiation monitor.

It is possible to see in the example that the actions on the action line were consider for the human and organisational factors and shown as the conditions of the particular action. The barriers identified in the Barrier Analysis were added to the E&CF after that exercise was completed. The barriers are shown at the bottom of the chart in this example as blocks. The strength of the barrier is shown by the line that is used in the symbol.

Event and Causal Factor Chart - Page 3 of 6

Procedural Problems Caused LCO Entry and Challenged Safety Related Equipment



Barrier Analysis

A Barrier Analysis is also a systematic way of identifying the human and organisational factors in an event. As shown below, in completing the analysis systematically, the human and organisational factors are analyzed when determining why the barrier failed. In completing this mental exercise, the human and organisational factors of the event are reviewed.

The Barrier Analysis completed for the event used in the example above considered, channel separation, system train protection, control diagram, procedure quality, procedure revision process, control room mimic, pre-job briefing, work order sign on, peer checking, and self checking as possible barriers to the event. The investigation team considered as many barriers as were known to have been involved in the event. This was done as a means of understanding all of the human and organisational factors of the event. Not all of the barriers considered were found to be broken. In the factual review it was found that, as in the case of the work order sign on that the barrier functioned as expected.

The analysis for the procedure quality is shown below as the example. In using the guiding procedures such as the procedure writer's guide, the analysis is factually based. This contributes to the credibility of the analysis and identified causes.

Failed or Ineffective Barrier	How the Barrier Failed	Why the Barrier Failed	Corrective Action to Restore the Barrier to Effectiveness
Procedure Quality (Broken Barrier)	IMI-90.085 covers the 18 month calibration of the particulate, iodine and total gas (PIGS) monitor rotameters for 0-RE-90-132, 1-RE-90-106, and 1-RE-90-112.	Procedure IMI-90.085 combined the three rad monitors as a means of reducing the number of procedures and an opportunity for efficiency because they are the same model of monitor. Procedure WG-1.3-005 step 4.2 provides guidance for Writing for Multiple Components. Step 4.2[B], "Document multiple component performance using one of the following methods: 1. Providing a separate sequence of steps for each component. 2. If less than three additional sections would be required to document each component, break the components into separate sections. Therefore, the procedure writers guide does allow for multiple components to be included in one procedure with specific provisions on how they are addressed. Step 4.2[B]2 covers this instance. Following this guidance the three channels would be separated into	Revise procedure WG-1.3-005 step 4.2 to provide additional decision points as to the correct use of procedures with Multiple Components. The guidance should include consideration for system line up requirements and time of the testing.

		<p>three individual sections. This was not the case with IMI-90.085. the direction for the calibration were intermingled in the procedure. Though step 4.2[1] A,B, and C give specifics on the “applicable ODCM Controls or Tech Spec LCO” affected, step 6.2, Note 1 states that: “Steps [3] E, F, and G and [10] and [11] are N/A if this performance is on 0-RE-90-132. It did not recognize the shared lines between 1-RM-90-106 and 1-RM-90-112.</p> <p>There are portions that are separated for the three individual components such as 4.2[3], [4], and [5]. But this does not meet the procedure requirement for the separate sections.</p> <p>The calibration is not completed on all three of the rad monitors sequentially but as the work tasks are scheduled. Typically, components are combines when the procedure is started for one and the second and third are worked sequentially. The fact that this procedure is started and completed on three separate occasions for the three components is another factor to support the grouping as inappropriate.</p> <p>Another consideration as noted above is that there is a difference in the alignment between lower and upper containment required to support the purge for the three different rad monitors in the test. The shared sample line between 1-RE-90-106 and 1-RE-90-112 is not explicitly described to support the different line ups for the monitor purge.</p> <p>This barrier was found to be broken from the aspect that the shared sample line between 1-RM-90-106 and 1-RM-90-112 was not recognized and clearly articulated in the procedure covering the multiple components. The shared</p>	
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		sample line required unique system line ups to support the purge that was not included in the procedure guidance. IMI-90.085 does not follow the guidance and expectations in WG-1.3-005.	
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Change Analysis

Likewise in the Change Analysis, the human and organisational factors are analyzed in the review of the failed performance and the affect of the change as a causal factor. Similar to the Barrier Analysis, all known changes of the event are analyzed to determine if it was a cause of the event. The tool as designed looks at the who (personnel and supervision involved, experience levels, methodology, technique, right work group, etc.), what (parameters - plant condition, voltage, pump speed, levels, etc.), when (time - day, week, cycle, season, time in shift, shift rotation, etc.), where (location - what was the physical environment like, lighting, heat, space, etc.), how (guidance (procedures, policies, work direction, etc.), special conditions, procedures, training, communications, and management expectations. In completing the exercise of changes, the result is a thorough review of the factors of the event, both human and organisational.

In the example below, the ‘where’ analysis is shown. The complete change analysis reviewed all of the standard change considerations. It is important to analyze each of the standard factors. Though it may appear that the particular element was not involved by carefully looking at the event and the element, such as communication, additional learning may be found. In some cases people have eliminated some of the elements / factors in the analysis and a learning opportunity is lost. As shown in the example below of ‘where’, the investigation identified four aspects under the ‘Where’ heading. This is also another potential missed opportunity, if not all of the aspects are identified for analysis.

Change Analysis

RHR 50 Valve ΔP Project Installation Did Not Meet Expectations

Successful Performance: Unit 1 RHR ‘1A/1B’ DP Line installation

Unsuccessful Performance: Unit 2 RHR ‘2A’ DP Line installation and the cancellation of the ‘2B’ train

Factors That Influence Performance	Successful Performance	Failed Performance	Change?	Causal Factor?
Where – Location - what was the physical environment like, lighting, heat, space, etc.	Drywell - between 242 foot and 261 foot elevations.	Drywell – between 248 foot and 269 foot elevations.	No	No
	This work project was located in the Drywell. All other ‘company’ work was outside the drywell.	This work project was located in the Drywell. All other ‘company’ work was outside the drywell.	No	Yes - Because the work was in the Drywell it reduced the effectiveness of the oversight

				<p>model used by 'company'. The General Foreman who is responsible on several levels for the field oversight of all the 'company' projects was not as readily available for support.</p> <p>The project plan did not include a supervisor for inside and outside the drywell. This resulted in one supervisor attempting to cover the work inside the Drywell in addition to resolving the issues outside the Drywell.</p>
	The design for the piping run was based on drawing and pictures.	A visual was made of Unit 2 during a Maintenance outage.	No	No
	A command and control work location was established at the entrance to the Drywell. The Project Manager and Project Supervisor were positioned at the workstation for in the moment project status, craft direction, and issue	The Project Plan included a command and control work location at the Drywell entrance. The cable was pulled for computer access but the work location was not set up due to a challenge by Radiation Protection.	Yes	<p>Yes - The work location was challenged by Radiation Protection. A decision was made by PM 2 not to pursue resolution of the challenge. Nor was the challenge raised to management.</p> <p>The Command</p>

	<p>resolution. As craft personnel entered the drywell they received a briefing on the exact tasks that were to be accomplished during the entry. As craft exited the drywell they were debriefed on the status of the task and paper work was completed at the same time.</p>			<p>and Control Work Location was used by the PM and 'company' supervision during the Unit 1 outage. This change reduced the capability for immediate updates of the work in progress, the maintenance of the paper work and prompt issue resolution. This also eliminated the opportunity for task briefings on the work in progress.</p>
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Task Analysis

The same follows with a Task Analysis. It is important with this tool as well to use factually based information and to complete the analysis in its entirety. In this tool the human and organisational factors are analyzed when understanding the actual behavior in the event and then again in the determination of where the particular step was a causal factor. Experience has shown that if a procedure is used for the Task Analysis, consideration be given to using all of the steps of the procedure. This support the document credibility and thoroughness. In reviewing all of the steps, the analysis may provide the additional learning but can also point to precursors for a following step that was found to be a factor in the undesired outcome.

The example below is one step taken from a larger analysis. Each step of the procedure was reviewed.

Fuel Oil Leak Into Control Panel

Task Steps	Desired Action	Actual Behavior	Difference	Causal Factor
<p>5.10 Critical procedure steps are indicated by the symbol (\$). As each indicated step is completed, it shall be initiated on Sign-Off Sheet in Test Record Package.</p> <p>This step was changed in the last revision.</p>	<p>FCSG-7 Step 3.4 Critical Step – a series of steps, or action that, if performed improperly, will cause, irreversible harm to plant equipment, or people, or significantly impact plant operation (see risk-important action). Desired action is that the step(s) be performed correctly.</p>	<p>This practice was put in place in the 1991 procedure upgrade project. SO-G-30 Standing Order – Procedure Changes and Generation directs the procedure format.</p> <p>Industry standard is to have a sign off for each critical step in the body of the procedure.</p>	<p>The procedure is not human factored to industries standards.</p>	<p>Contributing Cause 1: The less than adequate quality of the procedure, including the lack of use designation, multiple action steps, human factoring do not support clear direction and understanding.</p>

Human Performance Evaluation System

The HPES also provides a methodical approach to considering the human and organisational factors of an event. In this tool as well, with thoughtful consideration for each of the twelve areas is critical to the identification of the factors of the event. The statements in the third section of each area provides a starting point for entry into a why stair case also. The statements in this third section can be used to better articulate the causes of the events. Though not all of the statements in this third section are cause statements, in that an additional why can be asked, they do support improved cause statements as opposed to ‘Management does not understand what good looks like’.

Conclusion

In conclusion, this paper explores solutions to some of the barriers that analysts are experiencing. The first solution is to clearly define in practice what human and organisational factors are and how they manifest themselves in an investigation. As noted in the paper people are already documenting the factors but are not recognizing them as such in some cases. In other cases they are focusing on the equipment factors because of comfort level and other cultural norms.

Many of the cultural norms can be addressed as laid out in this paper by systematically using the standard investigation tools. As noted in the above examples analysts many times short change the tools as they are designed to support perceived efficiency. This may be supported by the philosophical approach as to how the tools are used at each facility and what has become the accepted norm. Skepticism or resistance for a particular tool can be reduced by using factual information in the analysis, rather than subjective data or personal agenda.

It is important to note that not every tool lends itself to a particular event. It is up to the analyst to decide if a particular tool provides any meaningful analysis and learning. Some guiding procedures will suggest that at least two tools be used for a full root cause investigation. This guidance however, should not limit the use of additional tools for further learning opportunities.

The use of tools also lays out all known aspects of the event in a logical manner. Thus, it is possible when a cause is challenged, that the analyst can point to an analysis tool. If factual information and logic have been used in the construct of the analysis it is possible to respond by asking the challenger where there is an error in the logic. Many times a challenge to a cause cannot be supported with fact or logic if the analysis has not been completed completely or factually. This leaves the analyst and the investigation findings suspect.

Therefore, using the standard analysis tools as they were designed as a complete exercise will reduce and even eliminate many of the barriers that analysts currently face in their investigation experiences.

Dr. Petri Koistinen



**OECD / NEA
RCA Workshop Sept. 2009
Petri Koistinen**

13.4.2010

Etunimi Sukunimi

Teollisuuden Voima Oyj

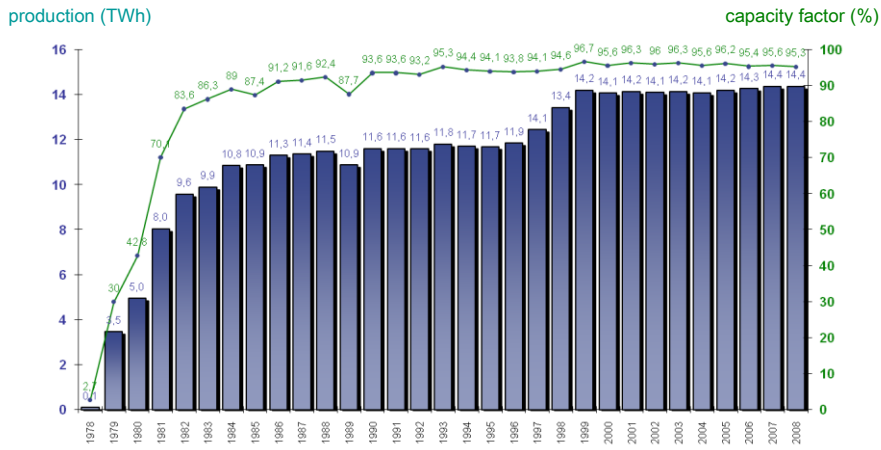


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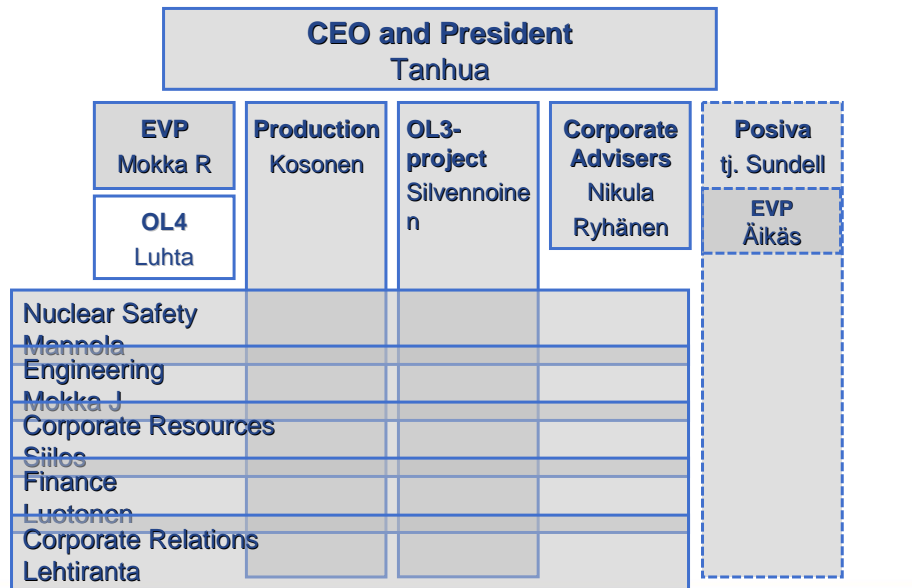
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OL1 and OL2 production and capacity factor



TVO – Basic Organization 1.7.2009



13.4.2010

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Corporate Personnel

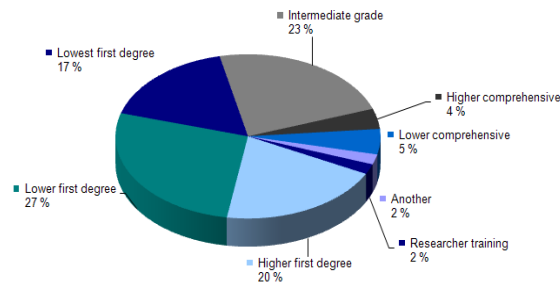
TVO:	789
POSIVA:	83
TVONS:	6
Total:	878



13.4.2010

Etunimi Sukunimi

Division by level of education



13.4.2010

Etunimi Sukunimi

Internal HOF specialist in NPP

- **Been there for 5 years, first of a kind in Finland**
 - still the only one
- **Background in social sciences**
 - M.A. (Psych.) and Dr. (Econ. and Business Admin.)
- **Located in HRM, corporate resources**
 - very independent role
 - first position was in operational safety
- **Fields of work:**
 - Investigations, incl. RCA
 - Safety culture
 - Human Performance program lead
 - HRD activities, like job satisfaction
 - Consulting, like Russia



13.4.2010

8
Etunimi Sukunimi

Role of an HOF specialist in investigations



There has always been enough prosecutors, someone has to be defence counsel .
"It takes the best people to make the worst mistakes"
-> What was leading a good professional to an error
-> "Human Error" is JUST a starting point

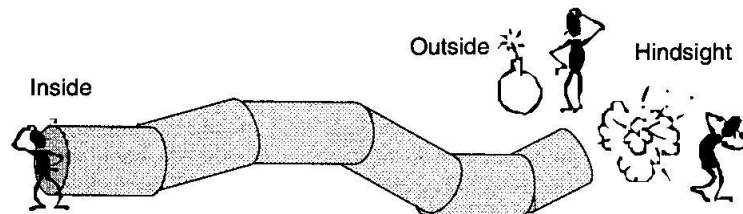


13.4.2010

Etunimi Sukunim⁹

Theoretical background

Retrospective:



Sidney Dekker: The Field Guide to Human Error Investigations, 2002



13.4.2010

Etunimi Sukunim⁹

What is a root cause?



Let's assume, that a severe weather conditions destroyed the plane,
Why did it fly there?!

-> A reckless pilot – Yes, if it was only a 'near miss'

-> Safety Culture of Air France – Yes, because it was an accident

Investigations in general

- **Learning from OE is an essential part of Organizational Learning in NPP's**
 - leadership and climate to learning support are also required
- **What – Why – How (CA's)**
 - also follow-up
 - RCA is pretty much about 'Why'

RCA in Finnish system

- **RCA is regulated by YVL-guidelines (see paper)**
- **Utilities own reporting practices are similar to RCA**
 - in depth and also nature of CA's
- **Altogether about 5 RCA-like investigations a year are conducted at TVO**
 - learning opportunities!
- **In Finland RCA's are typically done using case approach**
 - amount is also low, about one per company a year
 - taken seriously by the management



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13
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TVO practices in HOF, reporting/OE

- **Near misses**
- **Deviations**
- **Event / Special reports**
- **RCA**
- **Annual review of reports by HOF specialist**
- **Safety Culture Self-Assessments every three years**
 - IAEA approach
- **Evaluation of SMS every three years**
 - a new requirement
- **Special investigations**



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Lessons learned at TVO

- **Good practices**
 - Allow people involved to read and comment draft of the report before publishing
 - Collect all the parties when formulate CA's
- **Challenges in internal investigations**
 - Who decides CA's: line or investigator (team)
 - Competence, if too many people write reports, quality may



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Appropriateness of RCA's

It all comes back to Safety Culture;

“Safety Culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance” (INSAG 4)



13.4.2010

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A paper for the "CSNI/WGHOF Specialists Meeting on: Identification of Barriers to Analyzing and Identifying Human and Organisational Factors in Root Cause Analysis" in Paris September 2009.

Author: Dr. Petri Koistinen, Head of HRD, TVO /HOF and Safety Culture Specialist

Title: Doing HOF work in NPP - an internal specialist point of view

Organisational learning has been identified as one success factor both in general business literature and also in nuclear industry. One part of organisational learning is routines that support organisational learning. In nuclear industry learning from events is an important process of organisational learning. The other building blocks of learning organisation are climate that supports learning and leadership that encourages learning.

These have also been identified in nuclear industry as being important issues. Learning from events relies on the validity of the investigation process. Investigation process and report has simply three parts: what happened (facts), why it happened (analysis) and how to prevent reoccurrence (corrective actions, CA). In RCA analysis part is highlighted, however it cannot be done correctly unless the facts haven't been collected well. In a good learning process there must also be a follow up and feedback system for CA's.

Being HOF-specialist inside utility

TVO has had an internal HOF specialist since 2004. His main duties are event investigations (incl. RCA), or more generally operating experience work, safety culture improvement, human performance (WANO approach) and various other organisational development issues.

Human error has usually been an end point in event investigations, however HOF specialist work starts from that point. His task is to find out what was leading a good professional to an error. This kind of thinking requires a good safety culture, since blame-free or just culture is required to do this. Using terms of litigation, HOF specialist is an advocate, traditionally there has been enough prosecutors, i.e. people blaming bad apples.

RCA in Finnish system

In Finnish system RCA means highest and most complex class of reporting. Below that one are special reports (usually deviations from tech.specs.), which TVO writes 5-10 a year. Special report must be sent to the regulator within a month from the event. From the special reports some are chosen for RCA's. RCA must be sent to regulator within six months from the event. TVO conducts one RCA a year.

STUK YVL guidelines regulate reporting of NPP events. Generic requirements for event-based reports are in YVL 1.5. and specific requirements for RCA are given in YVL 1.11. (3.3.).

"Operational events which have, or may have, specific safety-significance and whose root causes are not obvious, shall be analysed by an appropriate root cause analysis method. Such events may include for example: special situations referred to in Guide YVL 1.5, clearly identifiable deficiencies in modes of action which might lead to a safety-significant event, common-cause failures and recurrent deviations which may have more extensive safety-significance. "

As can be seen in the guideline, RCA is implied for serious and far-reaching events. Guideline also mentions appropriate methods, however in Finland there is no established methodology for RCA's. This due to the small amount of RCA's (Loviisa conducts about the same amount as TVO). Lack of national level training, people working in event investigations are rather new in business and HOF in general is rather new in these areas in Finland. The tool most often used is barrier-analysis.

"Root cause analysis is performed to determine appropriate corrective actions for the removal of resolved root causes and other observed deficiencies and for the development of procedures. Judgmental attitudes towards individuals who have caused an operational event are not part of the analysis, however. This principle must infiltrate all levels of the organisation to facilitate the making and development of a functional operational experience feedback programme. (YVL 1.11.)"

This part clearly tells that RCA, as well as all the reporting, must lead to corrective actions and thereafter promote organisational development and learning. There is also a requirement for follow-up of effectiveness of CA's.

" Root cause, as referred to in this Guide, means such a common or systematic (not random) failure, deficiency or drawback as has significantly contributed to the occurrence of the analysed event. It is also characteristic of a root cause that the licence-holder can influence it by appropriate measures. A root cause thus cannot be a law of nature or actions, or modes of action, of an individual who is not a member of the component manufacturer's or licence-holder's staff. Also, a root cause is not a single human error or the failure or breaking of a component. (YVL 1.11.)"

RCA's are more HOF by nature rather than technical ones. Therefore in order to find 'real' RCA's competence in HOF is required in investigations. In this part of YVL guideline an interesting theme is appropriateness of RCA's and especially CA's that are based on them. CA's must on the other hand be realistic to fulfill and on the other have to lead an organisation to develop. This comes close to safety culture of the utility, CA's always require an organisation to change something, and as we all know resistance of change is almost law of nature in organisational development.

So formulating CA's is somewhat balancing between comfortableness and need to change. INSAG 4 definition is a good basis for evaluating appropriateness of RCA's and CA's, i.e. do we take the events seriously enough. INSAG 4 safety culture definition: "Safety Culture is that assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

"For root cause analysis, plant documentation, corresponding events excerpted from the event and failure register as well as records of the event in question shall be scrutinized. This can be done by interviewing those involved in the event and other knowledgeable individuals, and by monitoring corresponding work performances at the plant or at a simulator, if possible. (YVL 1.11.)"

YVL guideline highlights use of multiple data sources in RCA. This leads to need to have an investigation team that have sufficient competences to conduct the RCA. However in small utilities it might be difficult to find people who know the substance of the event and are independent enough to participate in the RCA. Interviews bring very important information from HOF's. Conducting interviews requires skilled people and also trust within the organisation. In safety culture, fairness is often mentioned and event investigations are a real moments of truth in this sense.

At TVO all the people involved in the event are usually interviewed. After all the interviews are done, a draft version of the report is written, especially the part dealing with facts and not so much with causes or CA's, and later it is sent to the people interviewed. This has proven to be a good practice for the sake of openness, trust and quality of findings.


RCA related practices at TVO

The amount of RCA's at TVO seems low, but this is mostly due to administrative reasons (regulator requirement). However TVO conducts 15-20 event investigations a year and some of them are RCA's in nature. The main goal of the investigations is to develop TVO's procedures and practices. Output of these investigations is called an event report.

Conducting an event investigation follows basically the principles as RCA, but due to the nature of events some requirements are adapted to the situation. RCA's are conducted by specially selected team and HOF specialist is always involved. Smaller event investigations are conducted mostly by line organisation. However in order to ensure quality of investigations and reports, HOF, OE and QA people always review the reports before they are accepted. One good practice in learning from events is to gather all the organisations involved to discuss about CA's, and some of these meetings have been very eye-opening for all the parties.

Responsible organisations and target days for all the CA's are set. CA's are recorded into a database where their level of implementation is followed. HOF specialist reviews all the reports from the past year in order to find common causes and weaknesses in the system. This review is presented to the plant management and it also includes recommendations. TVO has conducted safety culture self assessments in 2004 and 2007 and will carry on doing them in three year interval. TVO follows IAEA approach to safety culture and therefore assessment also evaluates status of reporting and learning organisation.

Dr. Ryuji Kubota




Japanese situations to emerging themes

Japan Nuclear Energy Safety
Organization

KUBOTA Ryuji

CSNI/WGHOF Specialists Meeting on Identification of Barriers to Analyzing
and Identifying Human and Organizational Factors in Root Cause Analysis
Paris, France, September 21 - 22, 2009



1 Introduction

- The Japanese Government issued the revised Rule for the Installation, Operation, etc. of Commercial Power Reactors on **December 14, 2007** incorporating a requirement for the electric utilities to **implement the RCA** as one of the licensee's Fitness-for-Safety Activities.
- Licensees have experience to **identify the technical and human factors** for a long time. But licensees have a little experience to **identify the organizational factors** since licensee's RCA implementation required at December, 2007.
- Japanese regulatory body has **audited more than ten cases of the RCA implemented by licensees** since December 2007, and there were several cases which the periods to implement the RCA was **four to six months** till licensees completed the comments pointed by the regulatory body.

● ● ● | 2 Japanese situations to emerging themes

1. We **approve of opinions** to emerging themes in “CSNI Activity Plan”, and based on achievements of **more than ten cases of licensee’s RCA audits**.
2. The **major contents** of Japanese situations to emerging themes are as follows.

● ● ● | 2.1 Role and Influence of Senior Management

1. The **direct cause** of the **Mihama accident** in 2004 was the aging deterioration of equipment.
2. But it was pointed out that there were **defects of the safety culture** because many back factors related management were identified in the **RCA**.
3. The regulatory body began to prevent the degradation of the corporate culture and organizational climate in 2005.
4. Therefore, senior managers well know that it is important to focus on compliance with the RCA process.

● ● ● | 2.2 Skill and knowledge of the investigators

1. The **causal diagram for risk management** is used by the methodology of **ex-ante prediction type**, and is selected all kinds of many factors that there are possibility to have risk.
2. The **causal diagram for RCA** is used by the methodology of **ex-post-facto learning type**, and is identified limited main factors only because of identifying HOF that an event has already occurred.
3. Most of licensees were apt to confuse the causal diagram for the RCA with one for risk management.

Table Difference between causal diagram for the RCA and one for risk management.

Items	Causal diagram for risk management	Causal diagram for RCA
Purpose	Preventive activity before an event occurs	Corrective activity after an event occurs
Methodology	Ex-ante prediction type (Deductive approach)	Ex-post-facto learning type (Inductive approach)
Number of factors	All kinds of many factors without omission for management	Limited main factors only by identifying HOF

● ● ● | 2.3 Qualitative nature of HOF

- In countermeasures of licensee's RCA, there were many cases that the practices that **licensees determined to be common sense were not absurd** from viewpoint of third party.
 1. 1 A man who has selected a responsible post of countermeasures has no responsibility and authorization.
 2. 2 As a strengthened training for non-routine works OJT (On-the-Job-Training) which selects normally as training for routine works has selected because licensee has not known the difference between OJT and Off-JT.
 3. 3 Licensee has described to review the requirements which do not described in the business plan.
- As one of countermeasures, it is useful that licensees sometimes have received an advice and technical support to the consultant outside the licensee's organization or prepared the list to categorize events or incidents such as categories of IRS .

2.3 Qualitative nature of HOF (continued)

1. There is **no illustration of CA (Corrective Actions)** for HOF to measure for effectiveness since licensee's RCA implementation required. However, we will continue the audits on the licensee's indicators to measure for effectiveness **in order to repeat PDCA cycle**.
2. As it is **impossible** to know if the root cause established by the analysis is **the true cause of the accident** and to **predict recurring accident**, CA for HOF is **difficult** to measure for effectiveness and it is **possible** to measure for effectiveness of **the reduction of recurring incidents**.
3. For examples, it is easy that selecting safety indicators and then measuring for effectiveness is on the results of the management of safety of the plant, i.e., so called **output indicators** such as **number of forced power reductions and outages due to internal causes, the frequency of events or near misses, number of failures in safety systems**.

2.4 Influence of the Regulator

1. As they have **no legal obligation** to be submitted a report of licensee's RCA to regulator, they explained to inspector in the audit.
2. Concerning the events that have significant impact on the safety, licensees recently submitted a report because the regulator required that licensees submitted reports for the RCA by the fixed date on two events.
3. As one report for the RCA results of these two events was **a good illustration**, this RCA has been available as a case study of **inspectors training**.

● ● ● | 2.5 Systematic Approach to investigations

1. According to **IAEA-TECDOC-1278**, organizational and managerial factors are not strongly supported by the methodology such as **HPES**.
2. As the main focus of **J-HPES** was on human factors, it could be identified the technical and human factors but was difficult to be identified the organizational factors.
3. The **RCA is limited by its retrospective** and inherently speculative nature^[2].
4. As **J-HPES** has identified the organizational factors of **JCO criticality accident** by enlarging from human viewpoint to organizational viewpoint of "causal classification list"^[3], the regulatory body has instructed licensees to enlarge to the organizational viewpoint and then the licensee's RCA implementation has improved.

References:

[2] Heidi Wald, Kaveh G. Shojania, Chapter 5. Root Cause Analysis of Making Health Care Safer: A Critical Analysis of Patient Safety Practices, AHRQ Publication 01-E058 July 20, 2001

[3] Furuta K, Sasou K, Kubota R, Ujita H, Shuto Y, Yagi E ,*Human factor analysis of JCO criticality accident*, Cognition Technology &. Work Vol.2 No.4 (2000)

● ● ● | 2.5 Systematic Approach to investigations
(continued)

1. In order that RCA analysts acquire the methodology to enlarge to the organizational viewpoint, they must know the difference between DCA and RCA. For examples, if a cause of DCA is a defect of a rule, an analysis of root cause is to analyze **a management level cause** such as why a defect of a rule has made or why a defect of a rule has overlooked until now.
2. If licensees share the information of a good practice on the results of RCA, it will realize to enlarge to the organizational viewpoint.
3. **As one of countermeasures**, a reference list of relations between organization factors is made beforehand and referred it in executing the RCA.
4. In order to be harmonized from several different levels of PSF to the same level, the reference list shall be prepared.
5. In Japan for the reference tool of the regulatory body to confirm licensees' RCA, inspectors for nuclear facilities used "**JNES Organizational Factors List (JOFL)**".

3 JOFL classification

JOFL is systematized as "Reference List"

1. Composed of **6 key factors** structured by **63 intermediate classifications** and **137 viewpoints**
2. Questionnaire for the confirmation of each viewpoint as a reference list of "The NISA Guideline"

3 JOFL classification (Cont'd)

No.	Key factors	No.	Intermediate classification
1	1.External environmental factor	1-1	economic status
		1-2	regulatory response policy
		1-3	external communication
		1-4	general reputation
2	Organizational psychology factor	2-1	organization climate
3	Operational management factor	3-1	top management commitment
		3-2	organizational operation
		3-3	human resource management
		3-4	company policies and compliance criteria / standards
		3-5	communication between head office and power station
		3-6	self-evaluation (or the third party evaluation)
4	Intermediate management factor	4-1	division-manager level organization operation
		4-2	conformance to rules
		4-3	continuous education of organization
		4-4	personnel management
		4-5	communication
		4-6	procurement management
		4-7	human resources management related to organization structure
		4-8	engineering control
		4-9	work control
		4-10	change control
		4-11	non-conformance control
		4-12	corrective action
		4-13	documentation control
5	Group factor	5-1	inter/intra-party communication
		5-2	knowledge / education
		5-3	groupthink and decision-making based on principle of individuality such as a senior manager
6	Individual factor	6-1	knowledge / skill
		6-2	leadership
		6-3	ambitiousness / carefulness for safety
		6-4	ambitiousness for management
		6-5	concern about field staffs
		6-6	motivations, stress



4 Conclusion

- Licensees have experience to identify the technical and human factors for a long time. But licensees started to implement the RCA since December 2007 and they have a little experience to identify the organizational factor and no good practice on CA for HOF to implement and then measure for effectiveness.
- If licensees have a lot of experience, most of problems may be resolved. As CA for HOF is difficult to measure for effectiveness, we propose to **develop the outcome indicators to measure for effectiveness as one countermeasure of reducing barriers**.
- We will continue to evaluate licensee's RCA and develop the outcome indicators such as the frequency of events.

•**Heinrich's law** has been well known as the frequency law that there is a constant ratio between accidents, incidents and near-incidents of 1:29:300, and its conclusion points out that it is useful to analyze the frequent incidents to detect organizational problems before an accident happens and **the basic concept of RCA is based on this conclusion**.



4 Conclusion (cont'd)

- As **from another viewpoint of Heinrich's law** his law approximately follows **a particular mathematical function called "a power law"**, if the relation between frequency and degree of real incidents or near-incidents occurred in the nuclear power plants becomes completely a power law, it is named the same **"scale free"** as **the relation between frequency and area of forest fire**.
- As in Japan the regulatory body has required to implement the RCA for the nonconformity incidents of the violation of the licensee's fitness-for-safety program, we will also survey the factors caused the scale free by comparing the factors identified by RCA for the nonconformity incidents with the factors identified by RCA for the incidents that have significant impact on the safety in future.



Thank you very much for your attention !

KUBOTA Ryuji
Japan Nuclear Energy Safety
Organization



Japanese situations to Emerging Themes

Ryuji KUBOTA

Japan Nuclear Energy Safety Organisation (JNES)

Abstracts

Japanese regulatory body has audited more than ten cases of licensee's RCA since December 2007. We approve of opinions to emerging themes in "CSNI Activity Plan", and based on achievements of these audits, Japanese situations to emerging themes are explained. As our conclusion, the more experience to identify HOF licensees have, the more problems may be solved. But as CA is difficult to measure for effectiveness, we propose to develop the outcome indicators such as the frequency of events.

1 Introduction

The Japanese Government issued the revised Rule for the Installation, Operation, etc. of Commercial Power Reactors on December 14, 2007 incorporating a requirement for the electric utilities to implement the RCA (Root Cause Analysis) as one of the licensee's Fitness-for-Safety Activities.

The object of the RCA under the legal obligation of the licensee's fitness-for-safety program including technical specification is the events in the licensee event reports under Article 19 of the above mentioned revised Rules that have significant impact on the safety, the nonconformity incidents of the violation of the licensee's fitness-for-safety program and the events including the significant issues such as the analogous events that have not significant impact on the safety. And there are cases that electric utilities are positively implemented the self assessment or third party assessment of the RCA by their own free choice among the events other than those that are under the legal obligation of the licensee's fitness-for-safety program.

Licensees have experience to identify the technical and human factors for a long time. But as the requirements that licensees shall identify the organisational factors used by the RCA methodology have issued since December 2007, licensees have a little experience to identify the organisational factors.

Japanese regulatory body has audited more than ten cases of the RCA implemented by licensees since December 2007, and there were several cases which the periods to implement the RCA was four to six months till licensees completed the comments pointed by the regulatory body.

This paper is explained Japanese situations to emerging themes based on achievements of these audits and a guideline that regulatory agencies verify licensee's RCA.

2 Answers to Emerging Themes

We approve of opinions to emerging themes in "CSNI Activity Plan", and based on achievements of these audits, Japanese situations to emerging themes are as follows.

2.1 Role and Influence of Senior Management

1. Senior managers are willing to look at the organisation and their own behaviors for RC or problems are solved below their level in the organisation. In a case that problems are not solved below their level in the organisation, senior management including a division manager or a vice-superintendent participated in the RCA team.

2. On champion or sponsor for the RCA , the regulatory body required licensees to describe the methodology and implementation system in the licensee's fitness-for-safety program including technical specification, and to meet this rule the licensee's president declared commitments on fundamental policies for quality assurance as a champion for the QMS(Quality Management System).
3. Senior management looks at the RCA process as an opportunity to learn or the focus is on compliance with the process. And the regulatory body asked a question what lesson the RCA process gave to all senior managers such as a division manager, a vice-superintendent of site, etc. of licensees' RCA teams at the last meeting to audit licensee's RCA

The direct cause of the Mihama accident in 2004 was the aging deterioration of equipment. But it was pointed out that there were defects of the safety culture because many back factors related management were identified in the RCA. The regulatory body began to prevent the degradation of the corporate culture and organisational climate in 2005. Therefore senior managers well know that it is important to focus on compliance with the RCA process.

2.2 Skill and knowledge of the investigators

1. Training for HOF (Human and Organisational Factor) in the RCA is required. Licensees have experience in identifying the technical and human factors for a long time. But licensees have a little experience to identify the organisational factors since licensee's RCA implementation required at December, 2007 and it is difficult to identify them. Several licensees requested the supports of external experts. As the consultant outside the licensee's organisation, licensees sometimes have received an advice and technical support to JANTI (Japan Nuclear Technology Institute) and/or CRIEPI (Central Research Institute of Electric Power Industry).
2. There is adequate training available for the identification of organisational issues. But licensees have a little experience to identify the organisational factors used by the RCA.

The first step is to identify the direct cause related to the technical and human factors by the DCA (Direct Cause Analysis) for the nonconformity, and then is to identify the factors of root cause by implementing the RCA for the latent issues underlying the direct cause. Therefore there are a few factors of the root cause.

However as the DCA was implemented by the licensees' field employees and the RCA was implemented by QA (Quality Assurance) stuffs, the division of analysts between DCA and RCA was different. As the analyst of the RCA was not familiar to the results of RCA and started to investigate RCA and he identified the factors of RCA from viewpoints of risk management such as the preventive maintenance, there were many cases that he identified a lot of factors including unnecessary factors.

The cause-and-effect diagram (or causal diagram) for risk management shown in Table-1 is used by the methodology of ex-ante prediction type, and is selected all kinds of many factors that there are possibility to have risk. But the cause-and-effect diagram for RCA is used by the methodology of ex-post-facto learning type, and is identified limited main factors only because of identifying HOF that an event has already occurred.

Most of licensees were apt to confuse the cause-and-effect diagram for the RCA with one for risk management. As if selecting a lot of factors including unnecessary factors, their factors may prevent PDCA(Plan-Do-Check-Act) cycle from repeating because the licensees' field employee become busy to work out a lot of countermeasures, the regulatory body has instructed licensees and they have improved.

Table-1 Difference between causal diagram for the RCA and one for risk management

Items	Causal diagram for risk management	Causal diagram for RCA
Purpose	Preventive activity before an event occurs	Corrective activity or crosscutting activity after an event occurs
Methodology	Ex-ante prediction type (Deductive approach)	Ex-post-facto learning type (Inductive approach)
Number of factors	All kinds of many factors without omission for management	Limited main factors only by identifying HOF

3. It has previously been seen arrogance about the HOF such that technical people do not feel that special training is required. But there is recently a little arrogance in order to accept social comments.
4. Investigators must be experienced management in addition to be experienced within the organisation. According to the audits of licensee's RCA, there were a few cases that investigators who had been experienced management such as Procurement Management, Work Management, Process Management and so on could identify the organisational factors.

2.3 Qualitative nature of HOF

1. For the burden of proof, in order that the licensee's investigator is challenged the regulatory body required licensees to describe the methodology and implementation system in the licensee's fitness-for-safety program.

NISA (Nuclear and Industrial Safety Agency) published a guideline titled by "Guideline for Regulatory Agencies in Evaluating Contents of Root cause Analysis by Licensees (hereafter, abbreviating with "The NISA Guideline")" on December 14th in 2007.

Japan Electric Association established Commercial Standard titled "The guide of the RCA, The attached book of supplement version 2 in 2007, JEAG4121-2005 (JEAG= Japan Electric Association Guide)" on December 5th in 2007. After the regulatory body estimated that the contents of "The guide of the RCA" were conformed to the requirements of "The NISA Guideline", they endorsed it. Each licensee made a manual for the RCA based on "The guide of the RCA", and investigators implemented the RCA according to this manual.

In countermeasures of licensee's RCA, there were many cases that the practices that licensees determined to be common sense were not absurd from viewpoint of third party. For examples, the first case is that a man who has selected a responsible post of countermeasures has no responsibility and authorization. And the second case is that as a strengthened training for non-routine works OJT (On-the-Job-Training) which selects normally as training for routine works has selected because licensee has not known the difference between OJT and Off-JT.

The third case is that licensee has described to review the requirements which do not described in the business plan. The fourth case is that a procedure is described to switch over to a normal operation mode under the period of maintenance. As one of countermeasures, it is useful that licensees sometimes have received an advice and technical support to the consultant outside the licensee's organisation or prepared the list to categorize events or incidents such as categories of IRS(Incident Reporting System).

2. As licensees have identified factors that are disadvantageous to licensee's corporate, we guess that there is no problem to disprove the conclusions of the investigators.
3. The attitude to deal with qualitative data/ HOF issues by investigators and senior managers was positive.
4. There is no illustration of CA (Corrective Actions) for HOF to measure for effectiveness since licensee's RCA implementation required. However, we will continue the audits on the licensee's indicators to measure for effectiveness in order to repeat PDCA cycle. As it is impossible to know if the root cause established by the analysis is the true cause of the accident and to predict recurring accident, CA for HOF is difficult to measure for effectiveness and it is possible to measure for effectiveness of the reduction of recurring incidents. For examples, it is easy that selecting safety indicators and then measuring for effectiveness is on the results of the management of safety of the plant, i.e., so called output indicators such as number of forced power reductions and outages due to internal causes, the frequency of events or near misses, number of failures in safety systems.

2.4 Influence of the Regulator

1. The regulator imposes competency requirements for the RCA team. The requirements are as follows; A few members of the RCA team who have initiative over RCA shall have experience of safety preservation activities in nuclear power plant or shall understand such practice in addition to experience of education / training on RCA.

To meet this requirement, the RCA training is executed by JANTI and there are cases that electric utilities are independently executed the RCA training.

2. Licensees have been independently implemented self-assessment or third-party assessment on licensee's RCA. As they have no legal obligation to be submitted a report of licensee's RCA to regulator, they explained to inspector in the audit. Concerning the events that have significant impact on the safety, licensees recently submitted a report because the regulator required that licensees submitted reports for the RCA by the fixed date (approximately three months) on two events. As one report for the RCA results of these two events was a good illustration, this RCA has been available as a case study of inspectors training.

2.5 Systematic Approach to investigations

1. In order to ensure credibility of results, the regulatory body required licensees the neutrality of the analysis team, the objectivity of the data for analysis and the analysis results, and the logicality of the methodology used for analysis. For the methodology, the regulatory body requires that licensee's RCA shall present a systematic analysis that considers the viewpoints of organisational factors and their causal relationship.

At first most of licensees used J-HPES (Japanese version of Human Performance Enhancement System) developed by CRIEPI. According to IAEA-TECDOC-1278¹⁾, it is pointed out that organisational and managerial factors are not strongly supported by the methodology such as HPES. As the main focus of J-HPES was on human factors, it could be identified the technical and human factors but was difficult to be identified the organisational factors.

It has been described that the RCA is limited by its retrospective and inherently speculative nature²⁾. However as J-HPES has identified the organisational factors of JCO criticality accident by enlarging from human viewpoint to organisational viewpoint of "causal classification list"³⁾, the regulatory body has instructed licensees to enlarge to the organisational viewpoint and then the licensee's RCA implementation

has improved. In order that RCA analysts acquire the methodology to enlarge to the organisational viewpoint, they must know the difference between DCA and RCA.

For examples, if a cause of DCA is a defect of a rule, an analysis of root cause is to analyze a management level cause such as why a defect of a rule has made or why a defect of a rule has overlooked until now. If licensees share the information of a good practice on the results of RCA, it will realize to enlarge to the organisational viewpoint.

According to IAEA-TECDOC-1278¹⁾, HPIP (Human Performance Investigation Process) by the USNRC, MTO(Man-Technology-Organisation) by the Swedish NPP licensees, KHPES by the Korean NPP licensees and HPES (Human Performance Enhancement System) by the United Kingdom NPP licensees that are of the same methodology to J-HPES by the Japanese NPP licensees have the limitation in the following; "organisational and managerial factors are not strongly supported by the methodology." If the RCA used by these methods is not good, it should be enlarged to the organisational viewpoint.

As one of countermeasures, a reference list of relations between organisation factors is made beforehand and referred it in executing the RCA. In order to be harmonized from several different levels of PSF (Performance Shaping Factor) to the same level, the reference list shall be prepared.

In Japan for the reference tool of the regulatory body to confirm licensees' RCA, inspectors for nuclear facilities have trained to use "JNES Organisational Factors List" named LOFL⁴⁾.

2. The regulatory body requires licensee that a chronological diagram of the event is made based on the interview results, and that the concerned divisions and individuals in a diagram shall be specifically identified on the anonymous basis.
3. As the regulatory body requires that licensees implement both DCA and RCA, if after implementation of the DCA the RCA is implemented by using the results of the DCA, there is no problem that an opportunity is lost.
4. The regulatory body has required that licenses analyze the trending of lower levels events and select the repeated events or analogous events and then identify the common organisational issues among events by the RCA.
5. As the events to analyze trending are the repeated events or analogous events, to analyze trending does not focus compliance purposes but an opportunity to learn.

In chapter titled "4.2 View point to verify appropriateness for selection of events to be reviewed in the root cause analysis" of "The NISA Guideline", it is described that it shall be verified that the events selected as being included in the scope of licensee's RCA satisfy the following requirements;

1. Concerning the events that have significant impact on the safety, appropriate corrective actions and preventive actions shall be carried out and root cause analysis for each event shall be implemented to securely prevent recurrence. Example: Major safety-related accident, violation of safety preservation rules (Violation1-3), etc.
2. Concerning the events other than those that have significant impact on the safety, analysis of the accumulated data related to non-conformance shall be conducted after taking corrective actions and root cause analysis shall be implemented depending on the necessity to implement preventive actions. Example: Analogous event/repeated event, event for which involvement of organisational problem is suspected, etc.

3 Explanation of regulatory agencies in verifying licensee's RCA

3.1 Outline

NISA published "The NISA Guideline" on December 14th in 2007.

In addition to the judgment on whether or not the RCA satisfies the government requirements, audit should be made from the viewpoint to encourage further activities of the licensees to improve methodology, process and result of the RCA.

3.2 Viewpoint for regulatory agencies in verifying licensee's RCA

The items described in chapter 4 titled "Viewpoint for regulatory agencies in verifying root cause analysis implemented by licensees" of "The NISA Guideline" indicate the viewpoint to verify that the correction and corrective actions (or remedy) implemented by licensees based on RCA and its analysis results are appropriate.

Based on the regulatory requirements for RCA, three view points to confirm the process and the result of RCA are summarized as follows.

- The viewpoint to confirm that the neutrality of the analysis team is ensured.
- The viewpoint to confirm that the objectivity of the analysis results is ensured.
- The viewpoint to confirm that the logicity of the methodology used for analysis is ensured.

1. The viewpoint to confirm that the neutrality of the analysis team is ensured

For an accurate analysis implementation, it is required that neutrality of the analysis team and non-suffering disadvantage in personnel evaluation be assured. Also, to extract the organisational factors the interview to the senior managers should be indispensable.

Above mentioned considerations lead the four viewpoints shown in Table-2. Figure-1 shows an example of the relation among the members, the analysis team, and the members who take the lead in the analysis.

Table-2 Viewpoint to confirm the neutrality of analysis team in verifying licensee’s RCA

Contents
1. The analysis team shall be comprised of the divisions not directly involved with the event concerned.
2. Access to the essential data shall be authorized. Further, implementation of investigation including interviews to senior managements and the related divisions shall be ensured.
3. The individual who implemented the RCA shall be protected from the disadvantageous treatment associated with the analysis and its results.
4. The individual who has initiative over the RCA shall have experience of safety preservation activities in power plant or shall understand such practice in addition to experience of education / training related to the RCA.

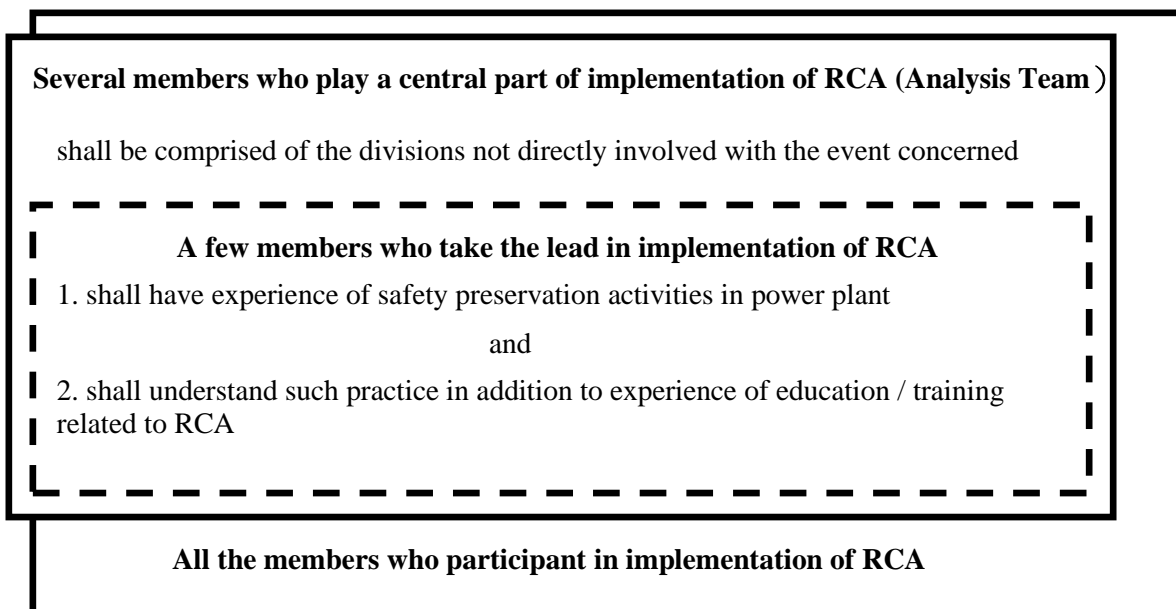


Fig.1 An example of the relation among the analysis team

2. The viewpoint to confirm that the objectivity of the analysis results is ensured

To be verified to confirm that the objectivity is ensured concerning the description contents that are indicated as the data for analysis and the analysis results, the four precise viewpoints shown in Table-3 are introduced. For more understandability, the specific example of each viewpoint is specified.

Table-3 Viewpoint to confirm the objectivity of analysis results in verifying licensee's RCA

Contents
1) In addition to the DCA results, collection of data necessary for root cause analysis and investigation including interviews shall be included.
2) If necessary, investigation on the similar events associated with the licensees concerned as well as those in domestic and international facilities shall be carried out.
3) The DCA results and the results of data collection and research shall be utilized in the RCA.
4) Results of analysis shall be summarized so that they can be understood by the third party.

3. The viewpoint to confirm that the logicity of methodology used for analysis is ensured

For this viewpoint to be verified to confirm that the logicity of the methodology used for analysis is ensured, the six precise viewpoints shown in Table-4 are introduced. Among these, number 3) is so-called "Stop Rule". It prevents from too shallow analysis or unnecessary expansion of analysis. The expression "as necessary" or "Depending on the need," included in number 2) and number 4) to number 6) means that these viewpoints should not be applied for every event in the same way but should be judged how to apply in case-by-case manner.

Table-4 Viewpoint to confirm the logicity of methodology in verifying licensee's RCA

Contents
1. The RCA shall present a systematic analysis that considers the viewpoints of organisational factors and their causal relationship depending on the reported events. As a reference list of organisational factors, JNES Organisational Factors List named by JOFL is referred.
2. Trans-sectional analysis on events, data and investigation results from various viewpoints shall be conducted as necessary to explore common factors.
3. The analysis shall have such a dept as to be able to improve inappropriateness of the management system..
4. As necessary, inappropriateness of the past correction and corrective actions (or remedy) shall be reviewed.
5. As necessary, difference factors caused by change and modification before and after the event concerned shall be analyzed.
6. As necessary, analysis shall be conducted whether or not there was no barrier to prevent event occurrence or human error, whether or not such a barrier was lost or dysfunctional.

3.3 The current situation of the regulatory body and licensees

The methodology used by licensees for the RCA should not be regulated. Therefore, licensees adopt a wide variety of the RCA methodology to implement analysis. In order that the regulatory body confirms licensee's RCA by using "The NISA Guideline", inspectors for nuclear facilities have trained to use "JNES Organisational Factors List" named by JOFL. JOFL is systematized as "Reference List" which is composed of six key factors structured by 63 intermediate classifications and 137 viewpoints and the questionnaire for the confirmation of each viewpoint.

Six key factors are specified with "1.External environmental factor", "2.Organisational psychology factor", "3.Operational management factor", "4.Intermediate management factor", " 5. Group factor" and "6.Individual factor" which are referred in "viewpoint for organisational factors in the RCA" as a reference literature of "The NISA Guideline" are shown in Table-5. This table shows an example of viewpoints of the organisational factors in the RCA to verify that the RCA should present a systematic analysis that considers the viewpoints of organisational factors and their causal relationship depending on the reported events.

Japan Electric Association established Commercial Standard titled "The guide of the RCA" on December 5th in 2007. After the regulatory body estimated that the contents of "The guide of the RCA" were conformed to the requirements of "The NISA Guideline", they endorsed it. Each licensee made a manual for the RCA based on "The guide of the RCA", and investigators implemented the RCA according to this manual.

Table-5 JOFL key factors and their explanations

Key factors	Explanations
1. External environmental factor	The factors related to external environment outside of self-organisation concerned can be included in the candidates of organisational factor, if the impact of "economic status", "regulatory response policy", "external communication" and "general reputation" etc. on the organisation concerned has involvement with the issue concerned.
2. Organisational psychology factor	The factors related to the common value among organisation members as a mode of thinking / behavior formed for a long period in the organisation (the population size of members such as corporate entity, power plant, division, group and team, etc.) that are expressed in a form of consciousness, awareness and behavior can be included in the candidates of organisational factor, if they have involvement with the issue concerned. (Note) They are called "organisation climate".
3. Operational management factor	The factors related to the operational management of the head office can be included in the candidates of organisational factor, if inappropriateness or lack of specificity / effectiveness of "top management commitment", "organisational operation (operation status, organisation structure, organisation objectives / strategies, decision-making of head office etc.) ", "human resource management", "company policies and compliance criteria / standards", "communication between head office and power station" and "self-evaluation (or the third party evaluation) " has involvement with the issue concerned.
4. Intermediate management factor	The factors related to the management operation of the power plant can be included in the candidates of organisational factor, if inappropriateness or lack of specificity / effectiveness of" division-manager level organisation operation (objectives / strategies, establishment of QMS, improvement of manuals etc.) ", "conformance to rules", "continuous education of organisation (handing-down of skills, reflection of operation experience) ", "personnel management", "communication", "procurement management (communication and control with cooperation companies) ", "human resources management related to organisation structure (role / responsibility, selection / arrangement, performance, education training) ", "engineering control", "work control", "change control (control at modification of organisation, control at change of work etc.) ", " non-conformance control", "corrective action", "documentation control" etc. have involvement with the issue concerned.
5. Group factor	The factors related to the party consisting each hierarchy of the organisation (Example : management level, division, section, team on shift, job team, etc.) can be included in the candidates of organisational factor, if their negative impacts of "inter/intra-party communication", " knowledge / education", "groupthink and decision-making based on principle of individuality such as a senior manager", etc. have involvement with the issue concerned.
6. Individual factor	The factors related to the individuals (employee / manager) consisting the organisation / cohort can be included in the candidates of organisational factor, if their impacts such as lack of "knowledge / skill", "leadership", "ambitiousness / carefulness for safety", " ambitiousness for management", "concern about field staffs", "motivations, stress" etc. have involvement with the issue concerned.

4. Prospects of RCA in future

Licenseses have experience to identify the technical and human factors for a long time. But licenseses started to implement the RCA since December 2007 and they have a little experience to identify the organisational factor and no good practice on CA (Corrective Actions) for HOF to implement and then measure for effectiveness.

If licenseses have a lot of experience, most of problems may be resolved. As CA for HOF is difficult to measure for effectiveness, we propose to develop the outcome indicators to measure for effectiveness as one countermeasure of reducing barriers.

Heinrich's law published in 1929 has been well known as the frequency law that there is a constant ratio between accidents, incidents and near-incidents of 1:29:300, and its conclusion points out that it is useful to analyze the frequent incidents to detect organisational problems before an accident happens and the basic concept of RCA is based on this conclusion.

As from another viewpoint of Heinrich's law his law approximately follows a particular mathematical function called “a [power law](#)”, if the relation between frequency and degree of real incidents or near-incidents occurred in the nuclear power plants becomes completely a power law, it is named the same “scale free” as the relation between frequency and area of forest fire.

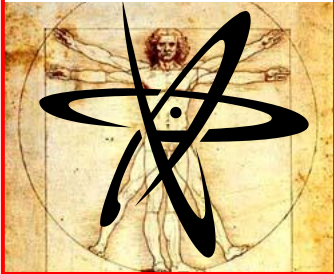
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APPENDIX H: INTRODUCTORY PRESENTATION

WGHOF



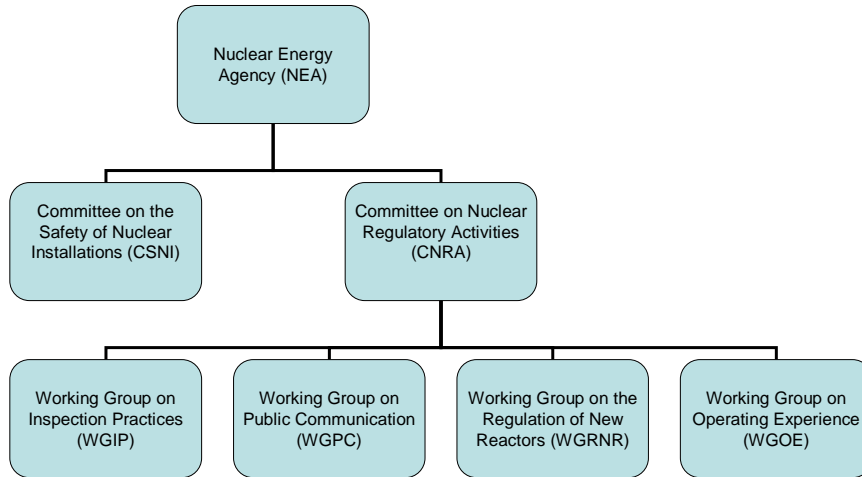
Special Experts Meeting

Identifying and Overcoming Barriers to
the Effective Consideration of
Human and Organizational Factors
in
**Event Analysis and Root Cause
Analysis**

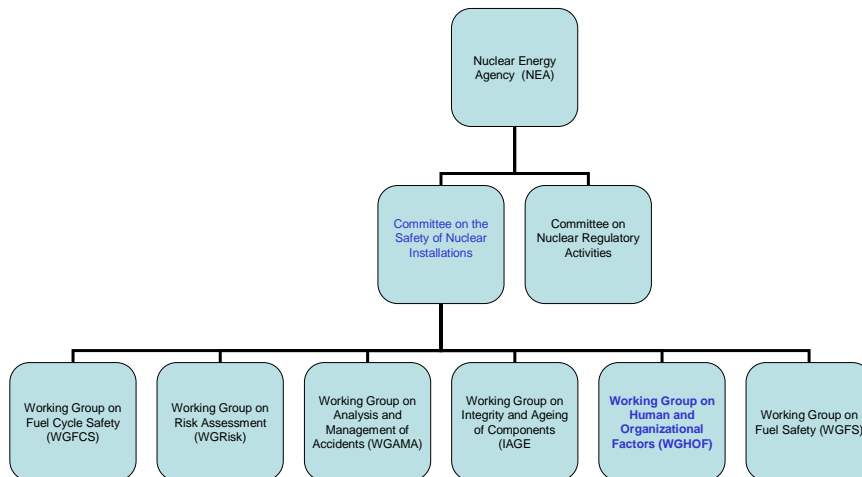
**Nuclear Energy Agency / Working Group on Human and
Organizational Factors**

September 21, 22, 2009

Organization for Economic Cooperative Development (OECD)



Organization for Economic Cooperative Development (OECD)



Working Group on Human and Organizational Factors (WGHOFF)

- The main mission of this group is to improve the understanding and treatment of human and organizational factors within the nuclear industry in order to support the continued safety performance of nuclear installations and improve the effectiveness of regulatory practices in member countries.

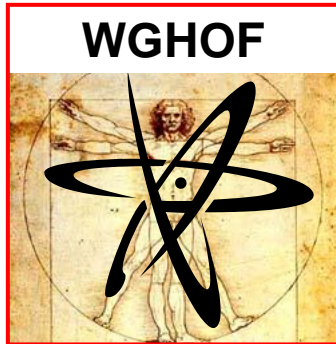


Working Group on Human and Organizational Factors (WGHOFF)

Recent Work:

- Justification of Organizational Suitability
- Licensee Safety Culture
- Human Performance in Maintenance
- Human performance and the operation of new nuclear plant technology (*new*)
- Organizational Factors in the Pre-operational phases of New Nuclear Power Plants (*new*)





Identifying and Overcoming Barriers to
Effective Consideration of
Human and Organizational Factors
in
**Event Analysis and Root Cause
Analysis**

CSNI Activity Plan

Project Scope and Justification

Nuclear licensees need to have:

- processes to identify the underlying causes of events
- effective processes for learning from operating experience
- secure continuous improvement defend against the potential for repeat events



Human and Organizational Factors in Root Cause Analysis

- estimated that 60 – 80% of the events in the nuclear industry can be attributed to human and organizational factors.
- the importance of correctly identifying the HOF causes is understood, but there is still a tendency to focus on the technical aspects of events
- history of prominent events across the major hazards sectors shows that HOF lessons fail to be learned.



What is the Problem?

- Why is it that utilities are still not focusing on the identification of HOF in RCA?
- What are the barriers which prevent the adequate treatment of HOF in RCA?
 - lack of knowledge / experience in HOF in RCA?
 - is resource availability a problem?



What is the Problem?

- Does the RCA training available adequately address HOF aspects of event analysis?
- Where HOF weaknesses are identified, are they difficult – perhaps even painful – for management to deal with such that corrective measures are not always implemented effectively?



Objective of the CSNI Activity Plan

Identification of:

- barriers to analyzing and correctly identifying the HOF causes of events
- barriers to implementing lessons learned from these analyses
- recommendations for overcoming these barriers and thereby improving the identification of HOF causes of events and supporting the successful implementation of appropriate corrective actions



Task Description and Milestones

- Clarification of concepts and development of a set of questions regarding the treatment of HOF in RCA: September 2008
- Presentation of questions to WGHOE / WGOE members: December 2008
- Responses received February 2009
- Analysis of information and preparation of themes: March - August 2009



Task Description and Milestones

- **Special Experts Group Meeting: September 2009**
- Discussion, identification and refinement of the issues regarding the barriers to the treatment of HOF in RCA and in implementing lessons learned
- A set of recommendations or good practices which will help in breaking down these barriers

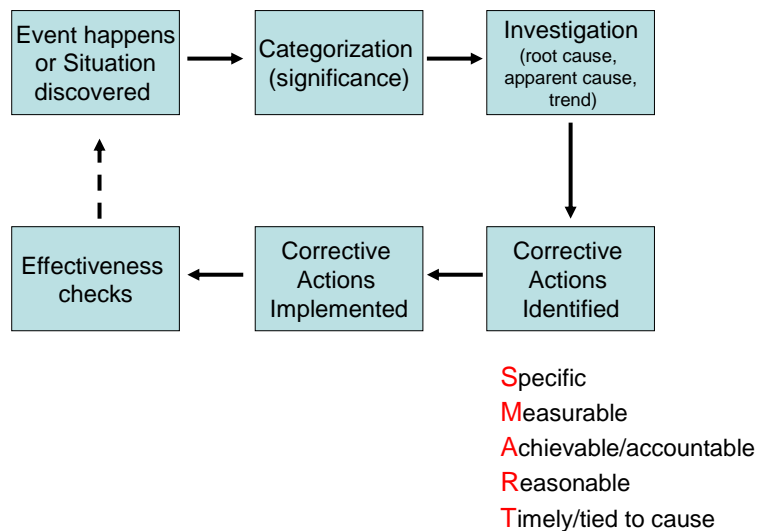


Survey Results

- 20 questions – based on the objectives of the CSNI Activity Plan: Identifying HOF in investigations, implementing lessons learned
- 23 Respondents, representing 10 countries
- Varying details in answers
- Insights/additional details provided in many cases
- Consolidated results will be provided in workshop proceedings



Generic Corrective Action Process



Objective 1

Identification of Barriers to analyzing and identifying Human and Organizational Factors in Root Cause Analysis



Categorization, Training, Methodology

- Categorize events for significance to determine which receive RCA
- HOF training of RCA members
 - HPES/TWIN/other, experience
 - HOF specialist included in some cases
- Tools methodologies address HOF?
 - varied responses (most “inadequate”)



Full time investigators, time limits

- RCA Team assignments
 - part-time (few done/year)
 - time guidelines don't affect quality
 - scope often determined by management
 - HOF expert not mandatory (one exception)

Time limits

- Targets, but could be extended
- Quality more important than schedule



Interview Senior Management Scope Setting

- Authority to interview Senior Management?
 - range of answers from “of course” to reluctance

Scope of investigation

- usually formal from management (often with RCA team input)
- A few indicated “free rein”



Characteristics of Success/Failure

- Success
 - experience of investigator(s)
 - management support/engagement
 - independence
 - RCA and/or HOF expertise
 - proper use of tools/methodology
 - good writing skills
 - well thought out corrective actions (SMART)



- Failure = opposite of above

Easy to identify HOF in RCA?

- Individual factors usually easy
 - Some challenges (fatigue, skill, time pressure)
- Organizational factors more difficult
 - Expertise, senior manager involvement, burden of proof
- Management support for effective identification of HOF in RCAs?
 - Yes, but....
 - Manager knowledge/understanding of RCA and/or HOF, resource commitment



Challenges to identify HOF in RCAs?

- Need experienced investigators trained in RCA and HOF
- Management support
 - independence, blame free culture, ability to be self- critical, resources
- Reluctance to tackle bigger issues
 - Cross functional (other's areas), only what can be easily fixed, quantitative versus qualitative



Objective 2

Identification of Barriers
to implementing lessons
learned from analyses



After RCA done, then what?

- Most indicated management team review of RCA results
- Corrective actions (CAs) accepted based on Root Causes found
- No differentiation between HOF versus other types of CAs
- CAs tracked in database



Success, Failure

- Skilled experienced investigators

Failure if:

- No management buy-in of CAs
- RCA inadequate, therefore CAs inadequate (unclear, not SMART)
- Reluctance/resistance to change



Measures of Effectiveness

- Most indicated checks done 6 – 12 months after CAs implemented
- Criteria varied – many mentioned “no repeat events”
- Many expressed difficulty in determining effectiveness



Lessons Learned / OPEX process

- Most mentioned Management support
- WANO/IAEA/VGB interfaces
- Benchmarking (only to other NPPs)
- Reviewed centrally
- Only one indicated routine interface with other high reliability organizations



Challenges to implement HOF CAs ?

- Management support
- Training to get right CAs for HOF
- Justification/explanation of CAs
- Resistance to change



Themes for Discussion

- Systematic Methodology/Tools
- Senior Management and Organizational Issues
- RCA Team composition/attributes
- Learning



APPENDIX I: LIST OF ACRONYMS

ACE – Apparent Cause Evaluation
CAPS – CSNI Activity Proposal Sheet
CNRA – Committee on Nuclear Regulatory Activities
CSNI – Committee on the Safety of Nuclear Installations
ECFC – Event and Causal Factor Chart
HOF – Human and Organisational Factors
IAEA – International Atomic Energy Agency
JNES – Japan Nuclear Energy Safety
MORT – Management Oversight and Risk Tree Analysis
NEA – Nuclear Energy Agency
NPP - Nuclear Power Plant
OECD- Organisation for Economic Cooperation and Development
OPEX – Operating Experience
OSART – Operational Safety Review Team
RCA – Root Cause Analysis
STUK – Radiation and Nuclear Safety Authority (Nuclear Regulatory Body, Finland)
TVO – Teollisuuden Voima Oyj
TWIN – Task Demands, Work Environment, Individual Capabilities, Human Nature
USNRC – United States Nuclear Regulatory Commission
WANO – World Association of Nuclear Operators
WGHOE – Working Group on Human and Organisational Factors
WGOE – Working Group on Operating Experience