



**TECHNICAL MEETING**

**ON**

**THE CONSIDERATIONS OF HUMAN FACTORS IN  
NEW NPP PROJECTS**

**INFORMATION SHEET**

**9–12 November 2010**

**IAEA Headquarters,  
Vienna, Austria**

## **1. PURPOSE OF THE MEETING**

The purpose of the meeting is:

- to provide an international forum for discussion on various aspects of human factors in new nuclear power plant (NPP) projects;
- to elaborate recommendations to be considered while undertaking new NPP projects, building new NPPs, embarking on nuclear power or expanding nuclear power programmes; and,
- to share information on training services on various aspects of human factors in NPP designs and projects, available in Member States and their organizations.

## **2. BACKGROUND**

In the nuclear industry, in particular, for the new NPP projects, technical aspects dealing with safety and efficiency are always focused on. Technical aspects always interact with human and organizational factors. Human and organizational factors (HOF) are those elements that influence the performance of people operating or maintaining equipment and systems, or undertaking projects or programmes; they include behavioural, medical, operational, task-load, management, machine interface and work environment factors. Consideration of HOF requires a systemic and integrated approach and incorporation of multidisciplinary contributions from psychology, engineering, industrial design, statistics, operations research and anthropometry. This systemic perspective is sometimes named as ITO - interaction between individuals, technology and organization. ITO is a wider concept than the original human factors concept. The role of humans in human-machine and organizational systems and how systems can be designed to work well with people, how human beings interact with technology as well as how technology affects human performance, particularly in regard to safety and efficiency, should be carefully considered. The science and experience have shown that the organizational factors play very important role, that suggests a broader perspective of the concept of human factors. Nowadays the concepts of human factors and ITO are more or less equivalent, however, in some applications human factors still have a more specific and narrow meaning. Therefore, in the following text, the term human factors is covering the two perspectives, the wider ITO and the more specific human-technology interaction.

Through event investigations and research, it was learned that up to 90 % of all events, incidents and accidents, are related to human and organizational factors; therefore, for undertaking projects in safe and efficient manner, human factors should not be underestimated. Human factors should be considered as a systemic and multidisciplinary field devoted to optimizing human performance and reducing human error; incorporating the methods and principles of the behavioural and social sciences, engineering, management, psychology and physiology. This is particularly important when designing, constructing and commissioning new NPPs.

While considering human factors in an NPP project, a wide range of aspects is to be taken into account, including those mentioned below.

The design shall be ‘operator friendly’ and shall be aimed at limiting the effects of human errors. The working areas and working environment of the site personnel shall be designed according to ergonomic principles. Systematic consideration of human factors and the human-machine interface shall be included in the design process at an early stage and shall continue throughout the entire process, to ensure an appropriate and clear distinction of functions between operating personnel and the automatic systems provided.

The human-machine interface shall be designed to provide the operators with comprehensive but easily manageable information, compatible with the necessary decision and action times. Verification and validation of aspects of human factors shall be included at appropriate stages to confirm that the design adequately accommodates all necessary operator actions.

The design shall be aimed at promoting the success of operator and maintenance staff actions with due regard for the time available for action, the physical environment to be expected and the psychological demands.

Reduced design complexity, reduced impact of human factors, and reduced operation and maintenance requirements, altogether should make the new generations of the NPPs safer, more efficient, as well as more attractive for the countries embarking on nuclear power or expanding their nuclear power programmes.

Human factors are among important aspects - while discussing safety - along with safety objectives, safety functions, defence in depth concepts, accident prevention, radiation protection and acceptance criteria, safety classifications, safety assessment and single failure criterion, common cause failure and redundancy, diversity and independence, and conservatism in design.

Reduction of human factors affecting safety systems is among innovative features of NPP designs. Inherent safety features (e.g. in context of passive safety systems) of the new designs to be ensured are that, by design, human factors cannot affect the safety systems.

Human reliability assessment models acknowledge the fact that human performance in operating a system (especially in performing cognitive, demanding tasks) is largely influenced by complexity characteristics of the system. Minimizing the complexity of a system, particularly in the early phases of its design, appears to be an attractive way of improving the system operation taking into account human factors. New approaches to design optimization which considers human factors at a very early phase in the conceptual design are being elaborated.

Probabilistic safety assessments and nuclear power experiences indicate that human errors make a major contribution to the global risk in existing nuclear power plants and are main contributors to occurrence of events. The traditional belief has been that human error is an individual employee focused phenomenon. This belief promotes the notion that failures are introduced in the system only at the individual level. However, weaknesses in organizational processes and cultural values have contributed significantly more to the occurrence of significant nuclear facility events than have individual mistakes. Organizational weaknesses are deficiencies, often hidden, in management processes or values creating workplace conditions that can lead to an error or degrade the integrity of procedures or systems that rely on a defence in depth strategy.

The frequency of errors can be reduced but never totally eliminated. The nuclear industry's focus on defence in depth is to design systems such that no individual failure, including human error, can lead to an accident. Improving individual and organizational performance in the nuclear industry needs to focus on both reducing the frequency of individual errors and minimizing the severity incurred when an error happens. Part of this is achieved by continually improving processes and organizational values, including making processes more error tolerant.

A fundamental aspect of any organization is its culture. At a nuclear facility, a key aspect of good performance is having a strong safety culture.

The desired organizational values to be advocated by all managers and personnel should:

- Foster a culture that values prevention of events;
- Strengthen defences to prevent or mitigate errors;
- Create an environment that encourages learning and continuous improvement.

Human factors should be seriously considered to ensure the appropriate safety culture during pre-operational phases of new NPPs. Lessons have been learned that the main focus on technical aspects of the construction can easily drag the attention away from the human and organizational aspects. In project management, the main focus is on quality, time, and money. To stick to the time schedule is one of the main tasks in project management. This can conflict, especially, when the time schedule is not realistic, with necessary safety precautions during pre-operational phases of nuclear power plants. There is also the common risk that the employees and the contractors engaged with the project have minor experience with the nuclear industry and its rigorous safety requirements. Vendors sometimes believe that safety culture belongs to the operation of nuclear power plants and not to the construction phase where they consider the emphasis to be on quality assurance. Sometimes it is difficult to get the message through to the field that “safety and quality has higher priority than cost and schedule”. There are other challenges related to human factors impacting safety culture: the projects may involve a very big number of companies/subcontractors, with many different nationalities and cultures; lack of experience in new nuclear builds due to many years without new constructions. The problems may be encountered at Vendor side, or Owner side, or Regulator side.

One of important aspects of considering human factors is the relationship to the attitudes, personal features and ‘soft skills’ of managers and personnel involved in various phases of new NPP projects including construction, commissioning and operation. This relates to the selection, recruitment, training, development, and performance assessment of staff in all organizations involved.

A large area for considering human factors is a human-machine system including optimization of a human-machine system; increasing a reliability of human-machine interface; and use of research / test facilities, modelling complexes and simulators for these purposes.

### **3. SCOPE OF THE MEETING AND PROPOSED TOPICS**

The meeting will include presentations of participants (from Member States and IAEA); discussions; and break-out sessions. Time will also be allocated for demonstration of software products and ‘face-to-face’ working level discussions.

The following topics are planned to be addressed:

- Consideration of human factors in the design process;
- Decreasing dependency of NPP designs on human factors;
- ‘Operator-friendly’ designs;
- Reduction of the impact of human factors on safety systems;
- Approaches, methods and practices of the design optimization which considers human factors at an early phase in the conceptual design;
- Designing working environment for reducing human errors;

- Considerations of human factors in the design of a human-machine interface; increasing a reliability of human-machine interface;
- Use of research / test facilities, modelling complexes and simulators for studies in the field of human factors, in optimization of NPP human-machine systems; and for designing and testing a human-machine interface;
- Improvement of safety and organizational culture within the projects on the new builds, including construction and commissioning phases;
- Advanced methods of improving organizational, process and individual (human) performance;
- Attitudes and personal features required for successful undertaking NPP projects in a safe and efficient manner (applies to all entities involved in an NPP project);
- Advanced methods for psychological and psycho-physiological testing / assessment of personnel;
- Information on training services on various aspects of human factors in NPP designs and projects, available in Member States and their organizations.

#### **4. AGENDA OF THE MEETING**

The agenda of the meeting will be developed using data received from the nominated participants and will be sent to the participants by the 8<sup>th</sup> of October 2010.

#### **5. PARTICIPATION**

Participants from countries already having nuclear power programmes, operating NPPs, expanding nuclear power programmes, and those who are embarking on nuclear power are invited.

Expected participants are personnel from organizations involved in new NPP projects: R&D organizations, academia, regulatory authorities, architect / engineer organizations, owners, operating organizations, nuclear power plants, vendors, companies involved in Engineering, Procurement and Construction (EPC) projects, training organizations, technical support organizations, and international organizations.

To provide opportunities to have in-depth discussions and information exchange, the total number of participants is limited to the thirty-five (35) persons. If more than 35 nominations are received, the Secretariat will consult with the designated authorities of related Member States to keep the total number to 35.

Participants should be officially designated by their relevant governmental authority (e.g. Ministry of Foreign Affairs or national atomic energy authority). The completed Participation Form (see Attachment 1) should be transmitted to the IAEA through official channels before **21 September 2010**.

#### **6. ORGANIZATION OF THE MEETING**

The Technical Meeting will be held from 9 to 12 November 2010 at the IAEA Headquarters in Vienna (a meeting room F0822 for panel sessions; and a meeting room F0879 for break-out sessions).

The working language of the meeting will be English.

Time for presentations at the plenary sessions will be limited to **20 minutes**.

Additional time (up to 20 minutes) may be provided to those participants who will demonstrate **software products** dealing with study of human factors in NPP designs; state-of-the-art, optimized human-machine interface; human reliability assessments; use of modelling complexes and simulators for studies in the field of human factors, in optimization of NPP human-machine systems; for designing and testing a human-machine interface; and for psychological and psycho-physiological testing / assessment of personnel.

Access to the Internet will be provided from a workstation installed in the meeting rooms. Projecting tools will be available. Laptops/notebooks brought by the participants may be connected to the projecting tools (LCD data projector) in the meeting rooms.

## **7. CHAIRPERSONS, SCIENTIFIC SECRETARIES AND ORGANIZERS**

The Chairpersons of the Technical Meeting (for panel and break-out sessions) will be appointed later. The recommendations from the Chairpersons will be reviewed in the final plenary session of the meeting together with any new recommendations provided by meeting participants.

### **Scientific Secretaries:**

#### **From the Department of Nuclear Energy:**

Mr Alexey Kazennov  
Division of Nuclear Power  
International Atomic Energy Agency  
Wagramer Strasse 5, P.O. Box 100  
1400 Vienna, Austria  
Tel: + 43 1 2600 22802  
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#### **From the Department of Nuclear Safety and Security:**

Ms Monica Haage  
Division of Nuclear Installation Safety  
International Atomic Energy Agency  
Wagramer Strasse 5, PO Box 100  
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Tel: + 43 1 2600 22551  
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E-mail: [M.Haage@iaea.org](mailto:M.Haage@iaea.org)

#### **Meeting Organizer:**

Ms Ludmila Pacalova  
Division of Nuclear Power  
International Atomic Energy Agency

Wagramer Strasse 5, PO Box 100  
1400 Vienna, Austria  
Tel: + 43 1 2600 22831  
Fax: + 43 1 2600 29598  
Email: [L.Pacalova@iaea.org](mailto:L.Pacalova@iaea.org)

## 8. PRESENTATIONS AND PRODUCTS FOR DEMONSTRATION

To identify presenters for plenary sessions and the exhibition of software products, the IAEA encourages participants to include the necessary information in the Participation Forms (see Attachment 1). Presentations and demonstrations of software at the plenary sessions will be selected on the basis of information provided; however, the meeting organizers will do their best to include all presentations offered in the meeting programme. Any individuals requiring early confirmation of suitability for the meeting of their presentation or demonstration of a product are encouraged to submit their Participation Forms in MS Word format as soon as possible to the email address [A.Kazenov@iaea.org](mailto:A.Kazenov@iaea.org) but not later than **21 September 2010**. Authors/presenters will be notified of the acceptance of their presentations for inclusion in the meeting programme by **24 September 2010**. Blank Participation Forms in MS Word format may be downloaded from the ENTRAC Library <http://entrac.iaea.org/> from a folder '2010 HF in NPP projects IAEA Vienna'. To register for ENTRAC please follow the instructions on the ENTRAC home page <http://entrac.iaea.org/>. (To reach the meeting folder in the Library: access ENTRAC; go to Library; access a folder 11 'IAEA conferences, technical and consultants' meetings'; access a folder 'H-field'; and access a folder '2010 HF in NPP projects IAEA Vienna'.) A navigation image how to find the meeting folder in the ENTRAC's Library is provided below:

### ENTRAC E-Library

Expand folders and subfolders to find document. Double click on the document to view it.  
New documents and the folders containing new documents are red-colored.

- 00 HRM & Training Services
- 01 Articles about our activities
- 02 IAEA NENP Newsletters
- 03 IAEA Nuclear Energy Department
- 04 Conferences-Flyers
- 05 IAEA publications in Human Resources, Performance and Training field
- 06 TWG-MHR
- 07 IAEA presentations in H-field
- 08 IAEA publications
- 09 Drafts
- 10 CDs (INIS, compiled IAEA publications)
- 11 IAEA conferences, technical and consultants' meetings
  - H-field
    - 2010 HF in NPP projects IAEA Vienna

All presentations, and also any actual software products or demo versions that the participants wish to be included in the meeting proceedings, should be transferred to the Meeting Organizer **during the meeting**.

Proceedings of the meeting will be published on ENTRAC after completion of the meeting.

## 9. LOGISTICS AND ACCOMMODATION

**Each participant is responsible** for her/his own hotel booking and transportation between the airport, hotel and meeting place. Tourist information may be found in Attachment 2 and also may be found on <http://www.info.wien.at>.

## 10. VISA

Designated participants who require a visa to enter Austria should submit the necessary application to the nearest diplomatic or consular representative of Austria well in advance of entry. An official letter of invitation will be issued to all designated participants by the IAEA Scientific Secretary. (Please see the **Visa Information** in Attachment 2).

## 11. EXPENDITURES

No registration fee is charged to participants.

The organizational cost of the meeting is borne by the IAEA.

Travel and all subsistence expenses are to be covered by the participants. Other details are provided in the letter being sent to the relevant governmental authorities.

## 12. DEADLINES

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|--|-------------------|
| - Nomination of participants by relevant government authority:<br>(Nomination letter and Participation Form sent to the IAEA<br>Through official channels and in parallel in MS Word format<br>by email to the Scientific Secretary) | 21 September 2010 |
| - Confirmation of a presentation acceptance:   | 24 September 2010 |
| - Programme sent to the participants   | 8 October 2010    |

**PARTICIPATION FORM**

IAEA TECHNICAL MEETING

TM-38870

**THE CONSIDERATIONS OF HUMAN FACTORS IN NEW NPP PROJECTS**

IAEA Headquarters, Vienna, Austria  
9–12 November 2010

**Please complete and send before 21 September 2010 through the competent official authority (Ministry of Foreign Affairs or National Atomic Energy Authority) with a reference to IAEA meeting TM-38870 to:**

Mr A. Kazennov  
International Atomic Energy Agency  
Wagramer Strasse 5, PO Box 100  
Vienna International Centre, 1400 Vienna, Austria  
Fax: +43 1 2600 29598  
Email: [A.Kazennov@iaea.org](mailto:A.Kazennov@iaea.org)

Surname:	
Given Name:	Mr./Ms:
Title (position):	
Institution/Organization/Company:	
Country:	
Full address:	
Tel:	Fax:
E-mail 1:	E-mail 2:
I intend to deliver during a plenary session a presentation <input type="checkbox"/> No <input type="checkbox"/> Yes, with the following title:	
Include a brief description of a presentation (up to 50 words)	
I intend to demonstrate the following software product(s):	
1.	
2.	
Include for each product the full name of a product and provide a brief explanation (up to 20 words)	
Date:	

## VISA INFORMATION

Should you require a visa for entering Austria please contact the nearest consular representative of Austria as early as possible.

**Please be aware that when applying for a visa you may be asked to show evidence of personal insurance coverage valid during your travel. It is your responsibility to make arrangements for health insurance coverage.**

Austria is a Schengen State and therefore persons who require a visa will have to apply for a “Schengen visa” **at least 4 weeks before entry into Austria**. In States where Austria has no diplomatic mission visas can be obtained from the consular authority of a Schengen Partner State representing Austria in the country in question. *[At present the Schengen States are: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and Switzerland.]*

Only in exceptional cases is the Agency able to assist participants who encounter difficulties in obtaining a visa. In this regard all necessary information (date of birth, nationality, type of passport, passport number, issuance and validity of the passport, length of stay, arrival date, flight details and a short description of the problem encountered) should be sent to reach the Agency at the latest **4 weeks** before the meeting. After that date the Agency will not be able to assist you due to Schengen regulations.

**Please be aware that the validity of a Schengen visa cannot be extended once you are in a Schengen State.**

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### LIST OF CONSULATES REPRESENTING AUSTRIA IN STATES WHERE THERE ARE NO AUSTRIAN DIPLOMATIC OR CONSULAR MISSIONS

#### **1. Belgium**

Burundi, Cameroon, Gabon, Rwanda, United Republic of Tanzania

#### **2. France**

Azerbaijan, Bahrain, Bangladesh, Benin, Brunei, Burkina Faso, Cambodia, Central African Republic, Chad, the Comoros, the Congo, Djibouti, Fiji, Georgia, Ghana, Guinea, Haiti, Laos, Lebanon, Mali, Mauritius, Monaco, Niger, Saint Lucia, Seychelles, Singapore, Togo, Trinidad and Tobago, Uganda, Vanuatu, Yemen, Zaire

#### **3. Italy**

San Marino

#### **4. Netherlands**

Bahamas, Mozambique, Suriname

#### **5. Portugal**

Angola, Cape Verde, Guinea-Bissau, Macao, Sao Tome and Principe

#### **6. Spain**

Andorra, Bolivia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Equatorial Guinea, Honduras, Jamaica, Mauritania, Nicaragua, Panama, Paraguay, Uruguay, United Arab Emirates

#### **7. Federal Republic of Germany**

Armenia, Belarus, Botswana, Cyprus, Democratic People's Republic of Korea, Iceland, Kazakhstan, Kyrgyz Stan, Madagascar, Malawi, Malta, Mongolia, Myanmar, Namibia, Nepal, New Zealand, Papua New Guinea, Qatar, Sri Lanka, Sudan, Tajikistan, Turkmenistan, Uzbekistan, Viet Nam, Zambia