

# Nuclear Safety Culture Assessment for a Newcomer Country

## *Case Study of Jordan*

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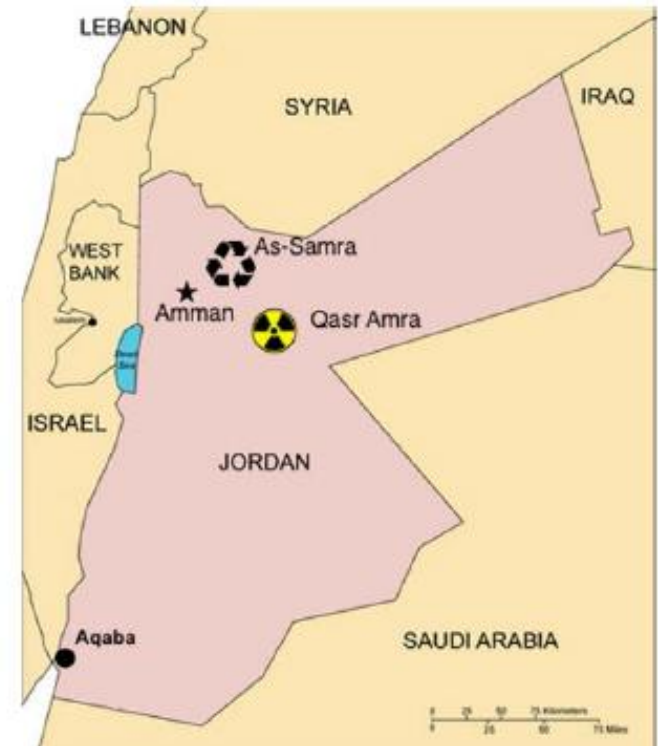
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# Overview and Objective

- Following the Fukushima Daiichi NPP accident an increasing attention was directed toward the **human factor** and the **safety culture** and their effect on the safe operation of the NPP.
- In some cases, the inadequate application of safety culture principles and practices in new build projects has been a contributing cause of safety issues during subsequent operation.
- A methodology to **quantify** the safety culture aspects of a nuclear power program is proposed.
- The aim is evaluate the safety culture aspects within a nuclear program and notice the drawbacks or the urgent items to be enhanced and direct the future planning of the program in order to guarantee the safe operation of the NPP.

# Jordan Country Profile

- **Total Area:** 89,213 km<sup>2</sup>.
- **Population:** 10 Million.
- **Main natural resources:** phosphate and potash.
- Current energy imports meet more than **90%** of the energy demand.
- Current electric power capacity is **2400MW**, expected to reach **8000MW** in 2030 and **16000MW** in 2040.



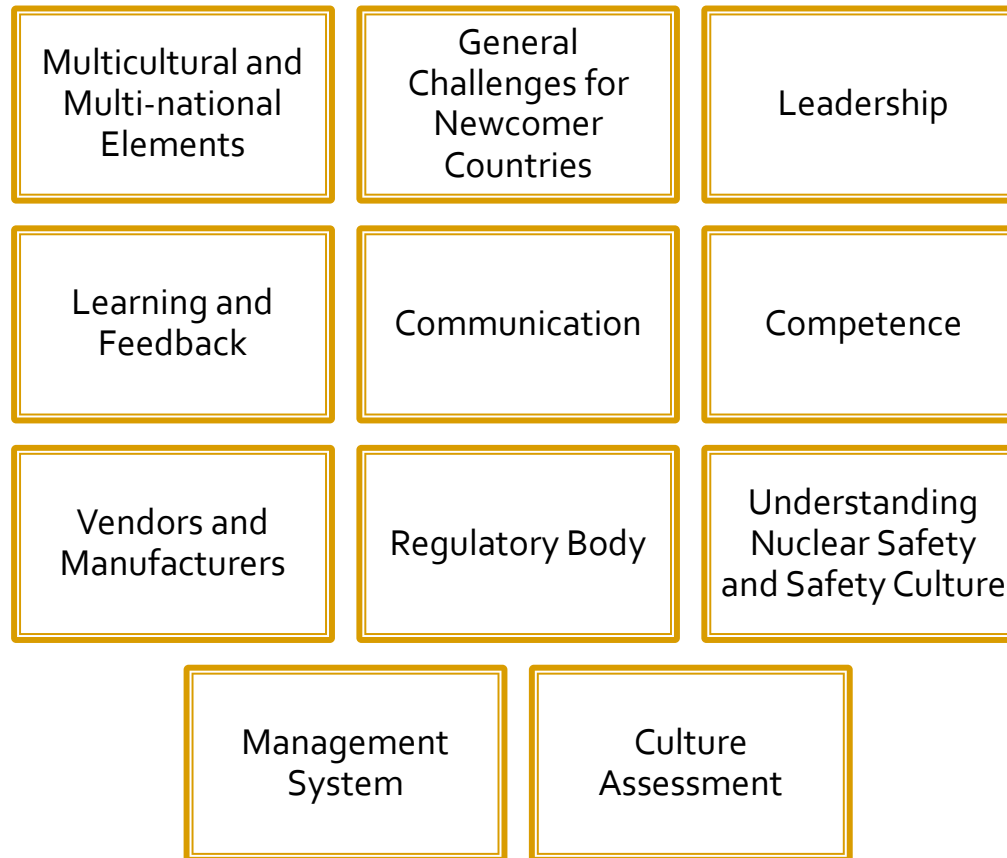
# Jordan's Nuclear Program

- **In 2006:**
  - Initiation of a national nuclear energy program.
- **In 2007:**
  - Jordan Atomic Energy Commission (JAEC) and Jordan Nuclear Regulatory Commission (JNRC) were established.
  - Establishment of a nuclear engineering department at the Jordan University of Science and Technology (JUST).
- **In 2008:**
  - Agreement with China to build Jordan Subcritical Assembly (JSA) at JUST.
  - JAEC launched site feasibility studies for the location of Jordan's first NPP.
- **In 2009:**
  - JAEC selected a South Korean consortium (KAERI and DAWOO) to build a research reactor, the JRTR.
- **In 2010:**
  - Location of the first NPP was fixed at the eastern part (*AL-Amra*) of the country.
- **In 2013:**
  - JAEC has selected the Russian's Roastom to be the nuclear technology supplier. (Two VVER-1200 reactors)
- **In 2016:**
  - The JRTR had reached its first criticality.

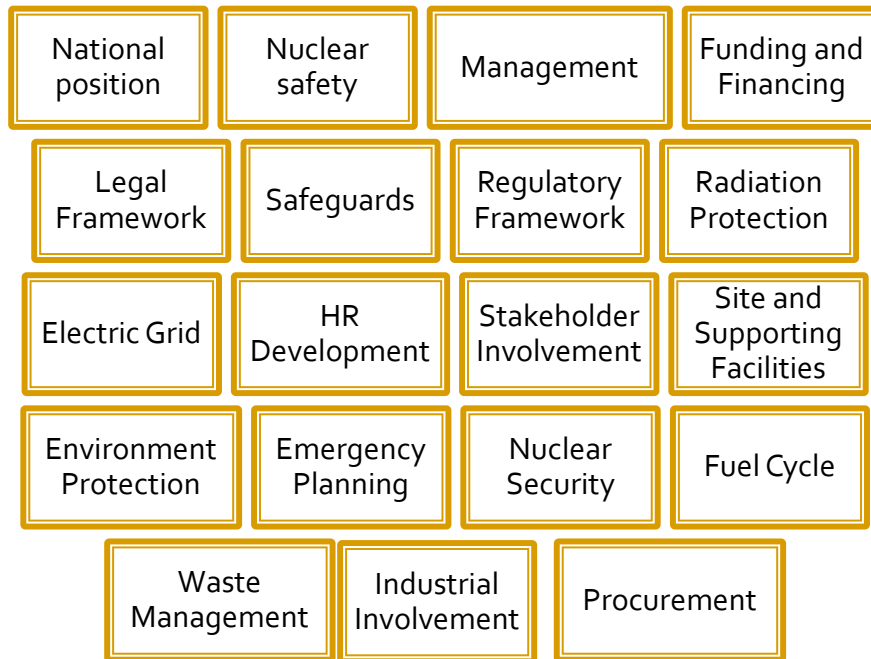
# Assessment Background

- The Jordanian case was selected since Jordan is in the early stages of its nuclear program and the establishment of an effective safety culture is crucial to guarantee the safe operation of its future nuclear facilities.
- The Jordanian nuclear program was evaluated based:
  1. **IAEA safety report No.74:** Safety culture in pre-operational phases of nuclear power project.
  2. **IAEA Integrated Regulatory Review Service (IRRS)** mission to Jordan.
  3. **IAEA Integrated Nuclear Infrastructure Review (INIR)** mission to Jordan.

- The IAEA safety report No. 74 addresses the safety culture aspects for a new nuclear program by list the main challenges expected to phase the newcomer countries, those challenges are:



- Two **INIR** missions to Jordan was conducted in 2009 and 2014.
- The INIR covers the comprehensive infrastructure required for building a nuclear power program. It covers **19** infrastructure issues.



- The **IRRS** mission to Jordan was conducted in 2014.
- The IRRS is designed to strengthen and enhance the effectiveness of the regulatory infrastructure for the country. It covers **10** aspects.



*There is **No** specific item in both the INIR and the IRRS reports that covers and evaluates the nuclear safety culture for a national nuclear program.*



# Evaluation and Ranking Process

- In order to decide the current status of the Jordanian nuclear program in accordance with the IAEA safety report No.74, each challenge and its sub-elements were evaluated and classified based on the IRRS and the INIR mission reports.
- For example, the IAEA safety report defined several challenges related to competencies and resource competition, one of them is:
  - The **range of required competencies**- from professional management, human factors and organizational development- **is not well defined**, and deficits in any of these areas can compromise the safety culture at various phases.
- This item will be evaluated based on the INIR or the IRRS missions to Jordan.

- The following paragraph is from the INIR mission report to Jordan.

**Plans need to be developed and implemented to meet the human resource needs for each organisation and integrated into a national plan.**

An initial assessment of the needs of the future operating organisation has been made but recruitment and training plans are yet to be developed. The need for further development of EMRC has been recommended by a recent IRRS mission. The HR requirements for other organisations addressing areas such as: technical support, waste management, nuclear security, safeguards, and local industrial involvement need further development. A national HRD committee has been established, but it has not yet conducted a gap analysis between needs and supply. There is a draft national HRD plan but it focuses mainly on the needs of the future operating organisation and the regulatory body. Jordan should further develop its organisational level and national level HRD plan and the means to meet those needs, ensuring consistency with the project schedule.

- It can be concluded that Jordan is **challenged** in defining the required competence and the establishing a plan for human resources development, those deficiencies can comprise the safety culture and the safe operation of the future power plants.

- The previous methodology of comparing the IAEA safety report No.74 items with the INIR and the IRRS mission reports has been conducted for all the challenges and their sub-elements.

	General Challenges for Newcomer Countries		Evaluation Basis
1	Early development of an independent, effective regulatory body	x	In 2007 an independent regulatory body was established JNRC
2	Lack of nuclear support organizations and infrastructure	Δ	The government depends on the international parties to provide the required support, however the need to develop a national organizations to provide the required support
3	Train national personnel	Δ	Several training programs were conducted, however specific training plans are yet to be developed.
4	Development of long term, fully integrated strategies	Δ	The general policies have been defined, however the polices related to nuclear fuel cycle and for radioactive waste management are not fully developed
5	Global competition for nuclear expertise and suppliers of technology, services and components.	x	Jordan has assigned the bid for the NPP for a Russian consortium and the RR for a Korean consortium

**X:** The challenge is not faced or a significant progress was already performed by the Jordanian government.

**Δ:** The challenge is partially faces, or a little progress was performed and more is needed to satisfy the IAEA requirements.

**O:** The challenge is faced and no significant progress to fulfill the IAEA requirements was observed.

	Leadership		Evaluation Basis
1	Ensuring leadership continuity through all phases of development in order to maintain and build a safety focus	O	Negative public acceptance and the shortage of funding impose constraints on the leadership development during different project phases
2	Constraints set by governments, owners or corporate bodies, which may emphasize business and economic concerns and may show a lack of understanding of the unique requirements involved in nuclear energy production	X	Effective management system with strong management commitment to safety and safety culture are considered to be established within the organization to ensure the consideration of safety and its importance through all phases of the project.
3	Avoiding the selection for leadership roles of people who prefer focusing on tasks or ideas rather than on people	△	The development of the capability requirements and training plans including evidence of leadership capabilities are being conducted by the regulator to ensure the competency and independence.
4	Ensuring alignment of individual leaders' personal goals with organizational objectives	△	Training and applying a strong management system to ensure applying and considering safety through all phases of the project.

- The following process was repeated for the whole items defined by the IAEA safety report No.74. (11 challenges with a total of 71 sub-elements).

**X:** The challenge is not faced or a significant progress was already performed by the Jordanian government.

**△:** The challenge is partially faces, or a little progress was performed and more is needed to satisfy the IAEA requirements.

**O:** The challenge is faced and no significant progress to fulfill the IAEA requirements was observed.

# Evaluation Table

- The evaluation process was performed for the 11 challenges and their sub-elements mentioned in the IAEA safety report No.74.
- Each challenge and its sub-elements were given a specific weight depending on its contribution to the total challenges.
- Each sub-element was given a total point of **5**, and based on the evaluation it was given a partial point as follow:

Evolution	Point
X	5
Δ	3
O	0

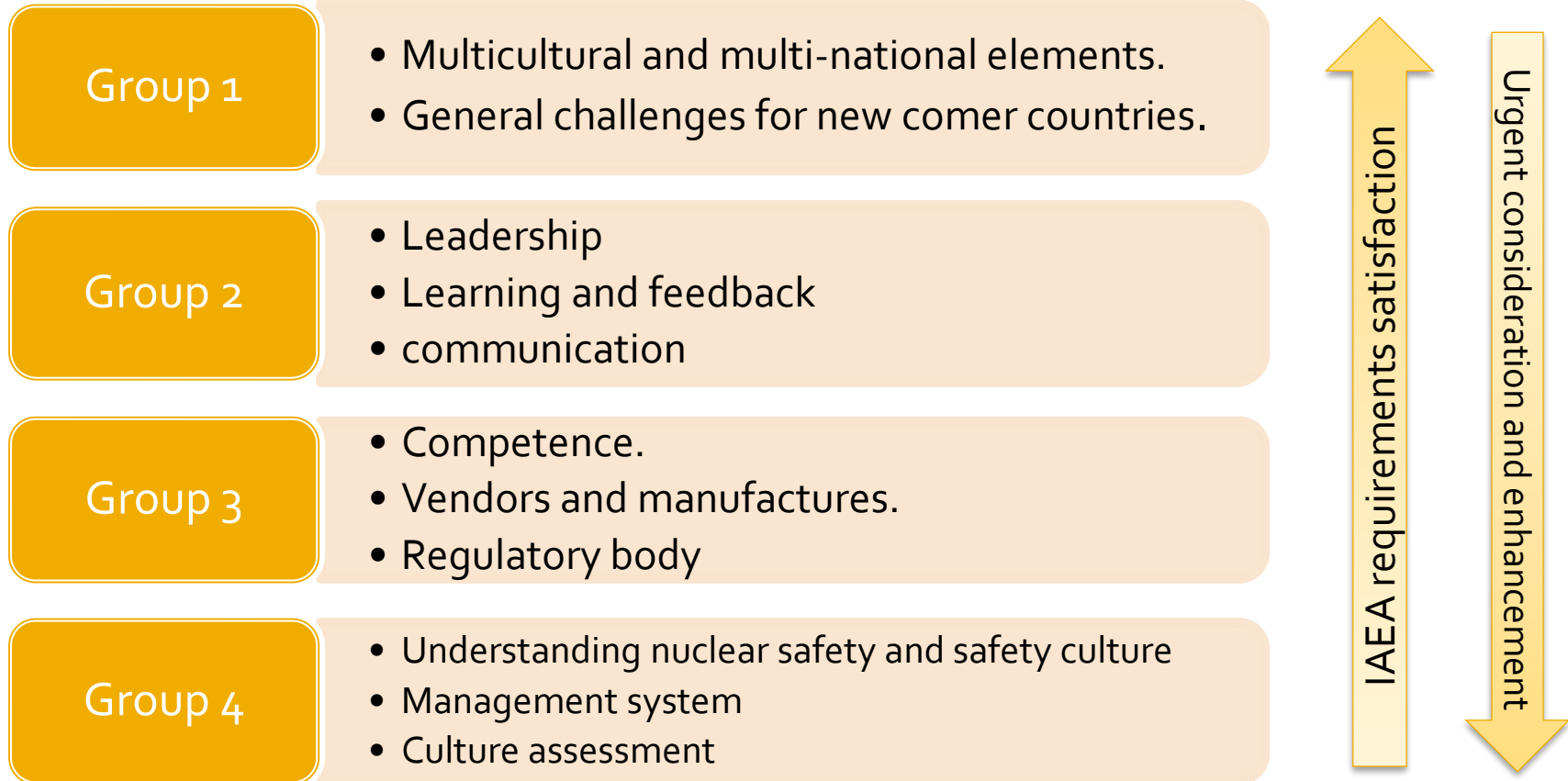
No. of sub-elements	X	Δ	O	Total weight	Evaluation value	%
<b>General challenges for newcomer countries</b>						
5	2	3	0	25	19	76
<b>Regulatory body</b>						
10	1	3	6	50	14	28
<b>Vendors and manufacturers</b>						
6	0	3	3	30	9	30
<b>Understanding nuclear safety and safety culture</b>						
11	1	1	9	55	8	14.54
<b>Multicultural and multi-national elements</b>						
4	2	2	0	20	16	80
<b>Leadership</b>						
5	1	3	1	25	14	56
<b>Competence</b>						
9	1	4	4	45	17	37.78
<b>Management system</b>						
5	0	1	4	25	3	12
<b>Learning and Feedback</b>						
6	1	3	2	30	14	46.66
<b>Culture assessment</b>						
3	0	0	3	15	0	0
<b>Communication</b>						
7	0	5	2	35	15	42.85

# Ranking Table

- From the evaluation table, the percentage of the fulfillment of the IAEA requirements for each challenge was obtained and then ranked, from highest to lowest, as shown in the table below:

	Challenge	percentage
1	Multicultural and multi-national elements	80
2	General challenges for newcomer countries	76
3	Leadership	56
4	Learning and Feedback	46.66
5	Communication	42.85
6	Competence	37.78
7	Vendors and manufacturers	30
8	Regulatory body	28
9	Understanding nuclear safety and safety culture	14.54
10	Management system	12
11	Culture assessment	0

- Based on the ranking the challenges can be grouped into **4 groups**.





# Conclusion

- The progress in the Jordanian nuclear power project in order to satisfy the IAEA requirements was quantified and ranked based on the INIR and the IRRS missions.
- Since Jordan has just started its nuclear program, significant effort yet to be made to fulfill the IAEA requirement.
- Elements in **Group 4**, cultural assessment, management system and understanding of the safety culture within the organizations, should be **urgently** considered and enhanced.
- Similar analysis could be done to other countries who are initiating their nuclear power programs, like the UAE and Saudi Arabia.
- A comparison between the different cases of several countries with different degrees of progress can be made in order to identify the important and urgent elements to be satisfied and recommendations for the newcomer countries could be made.

**Thank You for Listening**

**Q & A**