Fissile Material Controls in the Middle East

Steps Toward Middle-East Nuclear-Weapon-Free Zone

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Revision 4

Efforts to Establish a ME-NWFZ

1974, UN General Assembly

(sponsored by Iran and Egypt)

Resolution approved by First Committee and adopted by GA (with two abstentions)

(Since 1990, broadened scope of annual resolutions and SG reports to also include BW and CW)

IAEA General Conference, since 1991

Resolutions adopted by GC call "upon all States in the region to take measures [...] aimed at establishing an NWFZ in the Middle East"

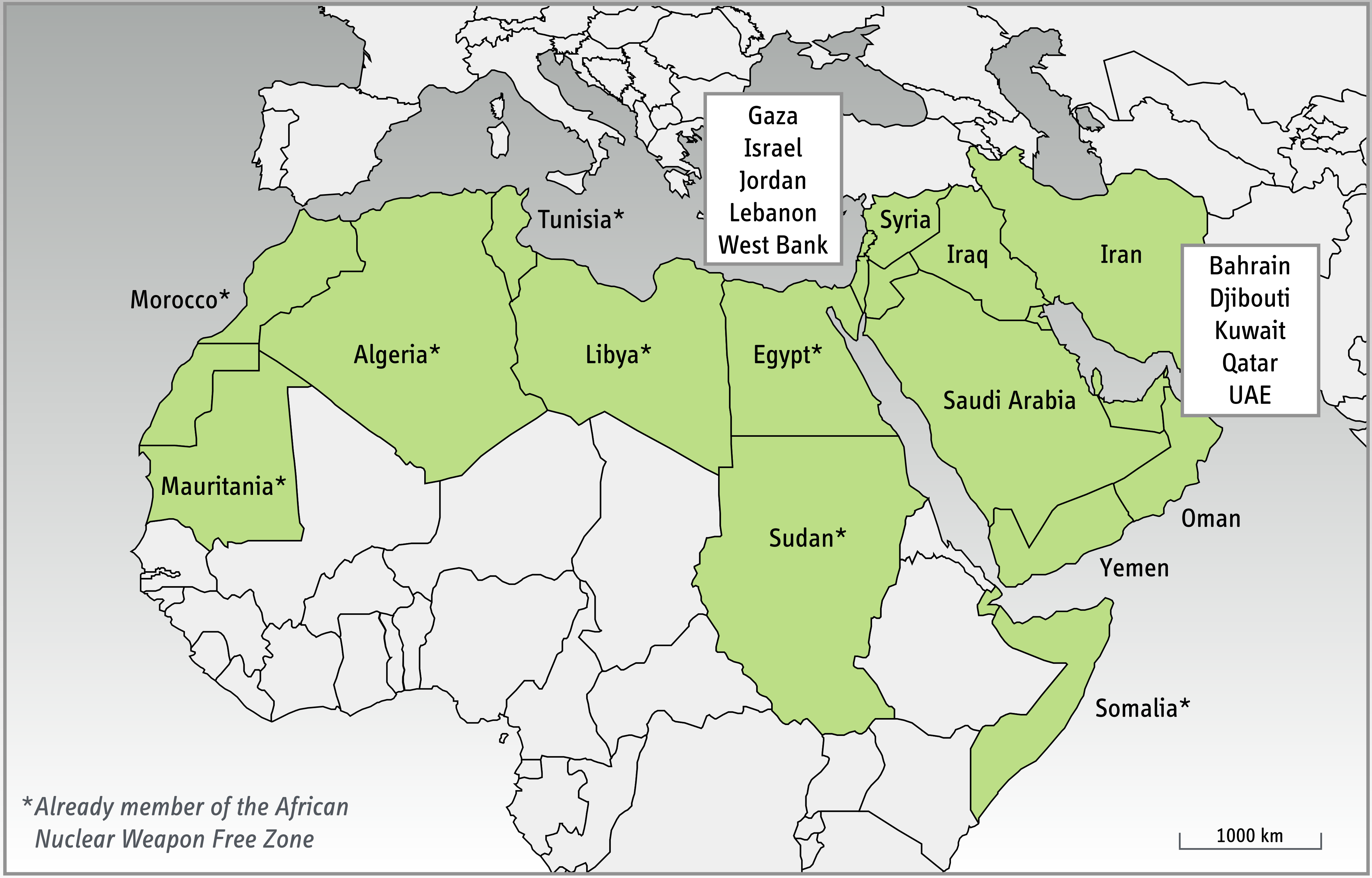
NPT Review Conference, especially 1995 and 2010

Establishment of the zone part of the "package deal" to extend the treaty in 1995

2010 final document tasked the UN-SG and co-sponsors to convene a conference on the zone "to be attended by all states of the Middle East" in 2012 (which has not taken place)

Candidate Members of a ME-NWFZ

League of Arab States, Israel, and Iran (based on recommendations from 1991 UN Study)



Challenges of a ME-NWFZ

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<u>History of Covert Proliferation Efforts in the Region</u>

Several countries in the Middle East
have been in violation of their NPT Safeguards commitments

For relevant discussion, see P. Goldschmidt, "Exposing Nuclear Non-compliance," *Survival*, 51 (1), 2009, pp. 143–164

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Iran's Nuclear Program

Includes plans for large-scale expansion of centrifuge enrichment program
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Israel's Nuclear Weapons Program

100–150 nuclear weapons; continued operation of unsafeguarded heavy-water reactor
(only non-member of NPT in the region)

Building Blocks

Key Building Blocks

1. Ban on the Separation of Plutonium

strengthened by a ban on natural-uranium-fueled reactors

2. Restrictions on Uranium Enrichment

Limits on enrichment level and move toward multilateral arrangements

3. Declarations of Fissile Material Stockpiles and Step-by-Step Safeguards

For unsafeguarded stocks, total inventory and safeguards for excess material

(skipping)

Ban on Plutonium Production

Strengthened by a Ban on Natural-uranium-fueled Reactors

Israel

and the Dimona Reactor

Dimona, Israel

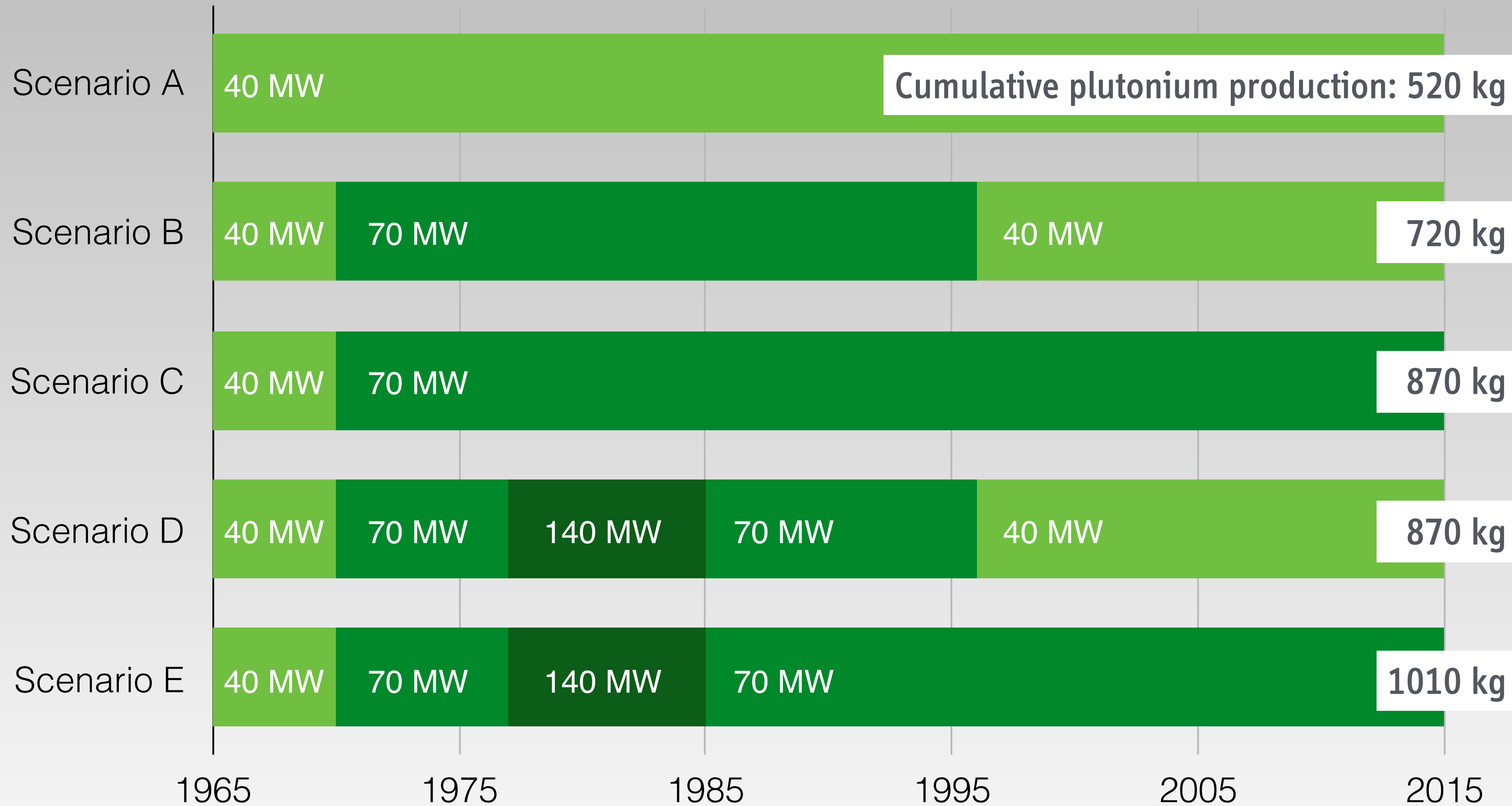
Coordinates: 31.00 N, 35.14 E

1. Dimona reactor

2. **Plutonium separation plant (Machon 2)**
   According to Vanunu, Machon 2 has two floors above ground and six floors below ground; besides plutonium separation, lithium-6 production, tritium extraction, plutonium pit production, and fabrication of other weapon components are carried out in Machon 2.

Possible Operational Histories of Dimona

(1965–2015, Production Scenarios A–E)



Note: Beginning of full-scale plutonium production at Dimona is uncertain; reactor went critical in 1962 and began operating in late 1963
Updated information, based on A. Glaser and M. Miller, 52nd Annual INMM Meeting, 2011

50 Years of Plutonium Production at Dimona

Estimated plutonium inventory by 2015: 850 kg ± 130 kg

(allowing for possible removals of about 20 kg in nuclear tests)

Current production rate: 10–18 kg/year, depending on Dimona's power level: 40–70 MW

Israel's nuclear arsenal is believed to include 100–150 warheads

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Plutonium production possibly more of a "byproduct" today

Main mission of Dimona now most likely tritium production

(Tritium could be produced with alternative non-reactor-based options)

Iran

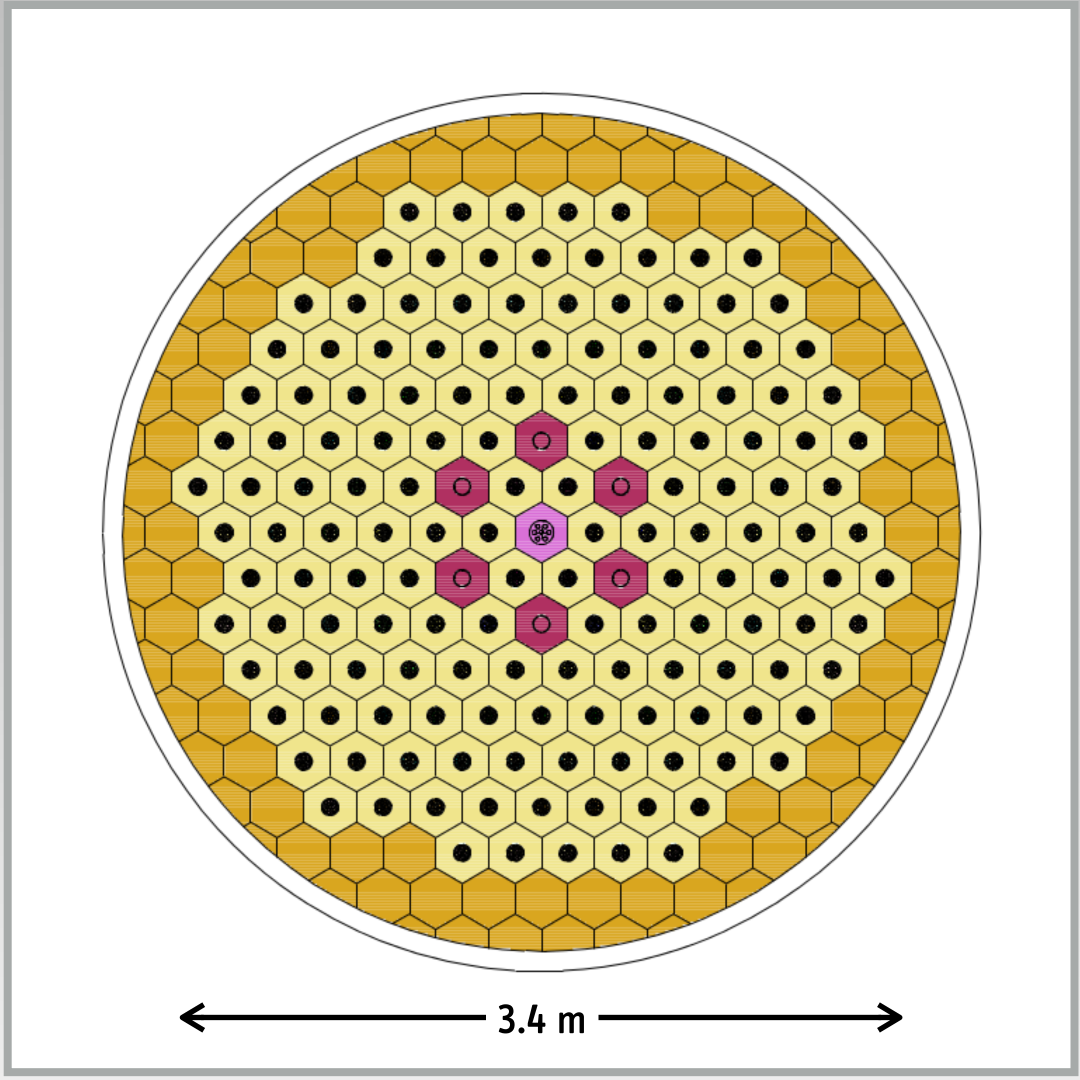
and the Arak (IR-40) Reactor

Iran's Arak (IR-40) Heavy Water Reactor

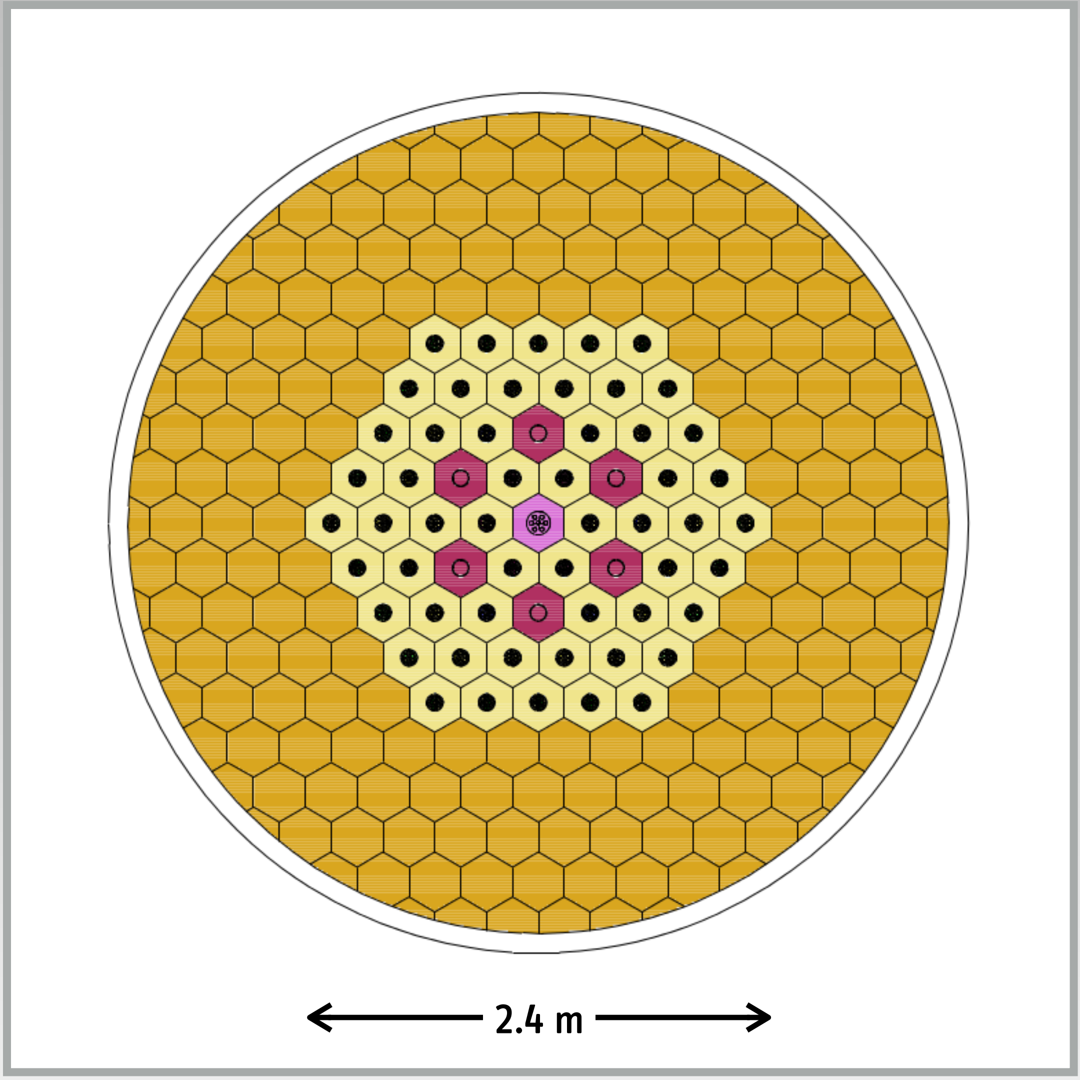
Source: Wikipedia; User: Nanking2012

Proposed Core and Fuel Modifications

Core uses 5%-enriched fuel and operates at a much lower power level



Original core
(40 MW with natural uranium fuel)

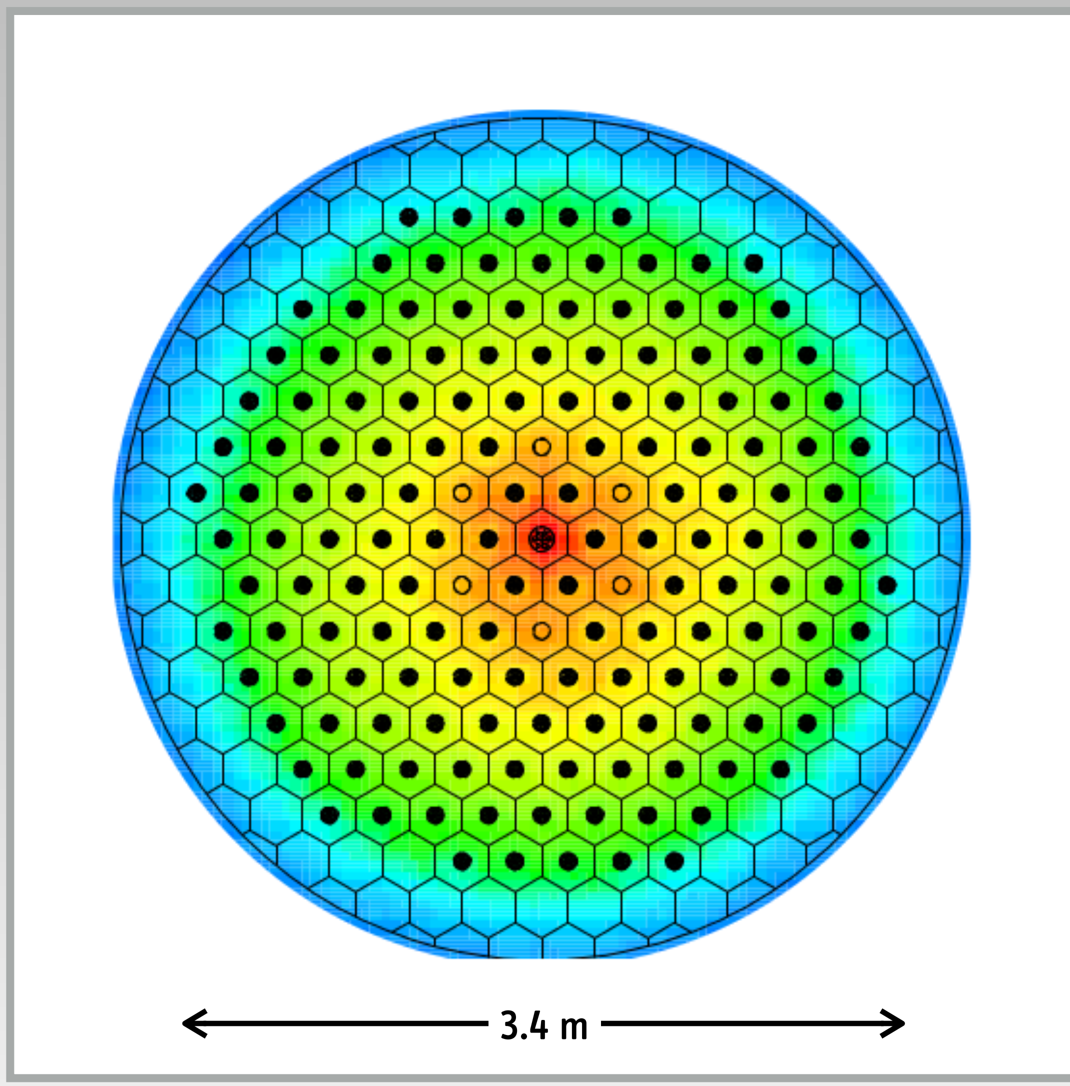


Modified core
(10 MW with 5%-enriched fuel)

A. Ahmad, F. von Hippel, A. Glaser, and Z. Mian, "A Win-Win Solution For Iran's Arak Reactor," *Arms Control Today*, April 2014
A. Ahmad, F. von Hippel, and A. Glaser, "Conversion Options for Iran's IR-40 Reactor," 55th Annual INMM Meeting, Atlanta, GA, July 2014

Proposed Core and Fuel Modifications

Core has a much higher neutron flux, which compensates for usability



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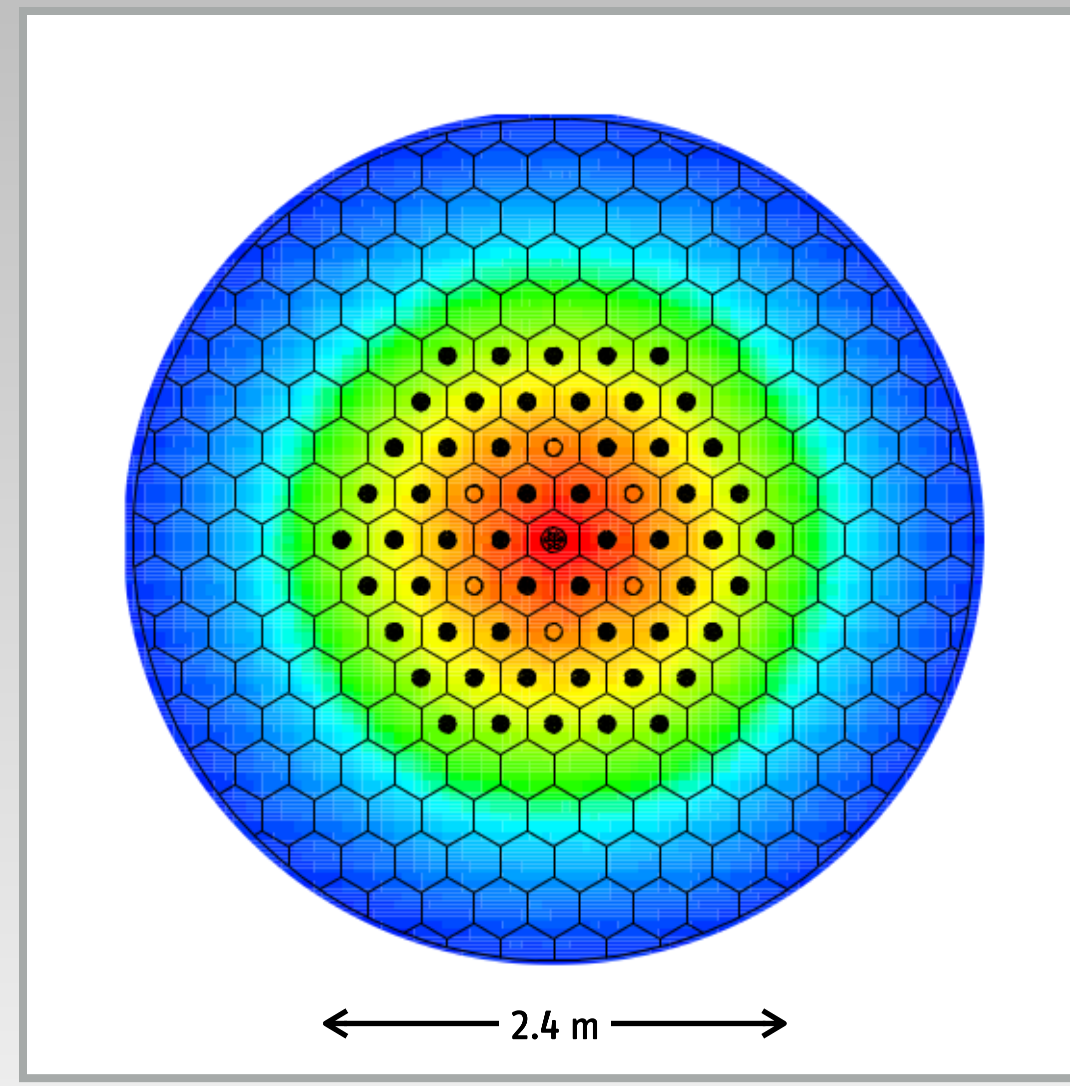

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Comparing the Original and the Modified Arak Reactor

	Current design (40 MW, natural uranium fuel)	Proposed Modification (10 MW, 5%-enriched fuel)
Plutonium production	24 grams per day	1.1 grams per day

Annual plutonium production in modified core is 400–420 g (down from almost 9 kg)

(Less than 1 kg for 20 MW option)

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Iran's Centrifuge Enrichment Program

As part of the P5+1 negotiations, Iran and the P5+1 could:

1. Agree on moratorium on increasing Iran's enrichment capacity until a specified date

Iran could continue centrifuge R&D and would store manufactured components under IAEA supervision

2. Agree to embark immediately on designing an effective multilateral framework for uranium enrichment in the region

One requirement could be that the same country cannot be technology suppler and host the facility

A. Glaser, Z. Mian, S. H. Mousavian, F. von Hippel, "A Two-Stage Strategy," *Arms Control Today*, July/August 2014

Verification Arrangements

Verification Arrangements

Mutual distrust in the region will require robust verification of any Middle East Nuclear Weapon Free Zone

Additional Protocol and Transparency Measures

Regional Nuclear-Fuel Cycle and Verification Organization

Capacity-Building (in the area of Verification) is Critical

Expertise is currently highly uneven; capacity needs to be there at the outset

Monitoring and Verification Tools

Transparency and onsite inspections are indispensable elements
but many of the early steps toward a ME-NWFZ could be verified initially
with fair confidence without direct access to some sites

Selected Objectives of a Verification Regime for a ME-NWFZ

Reactor Status

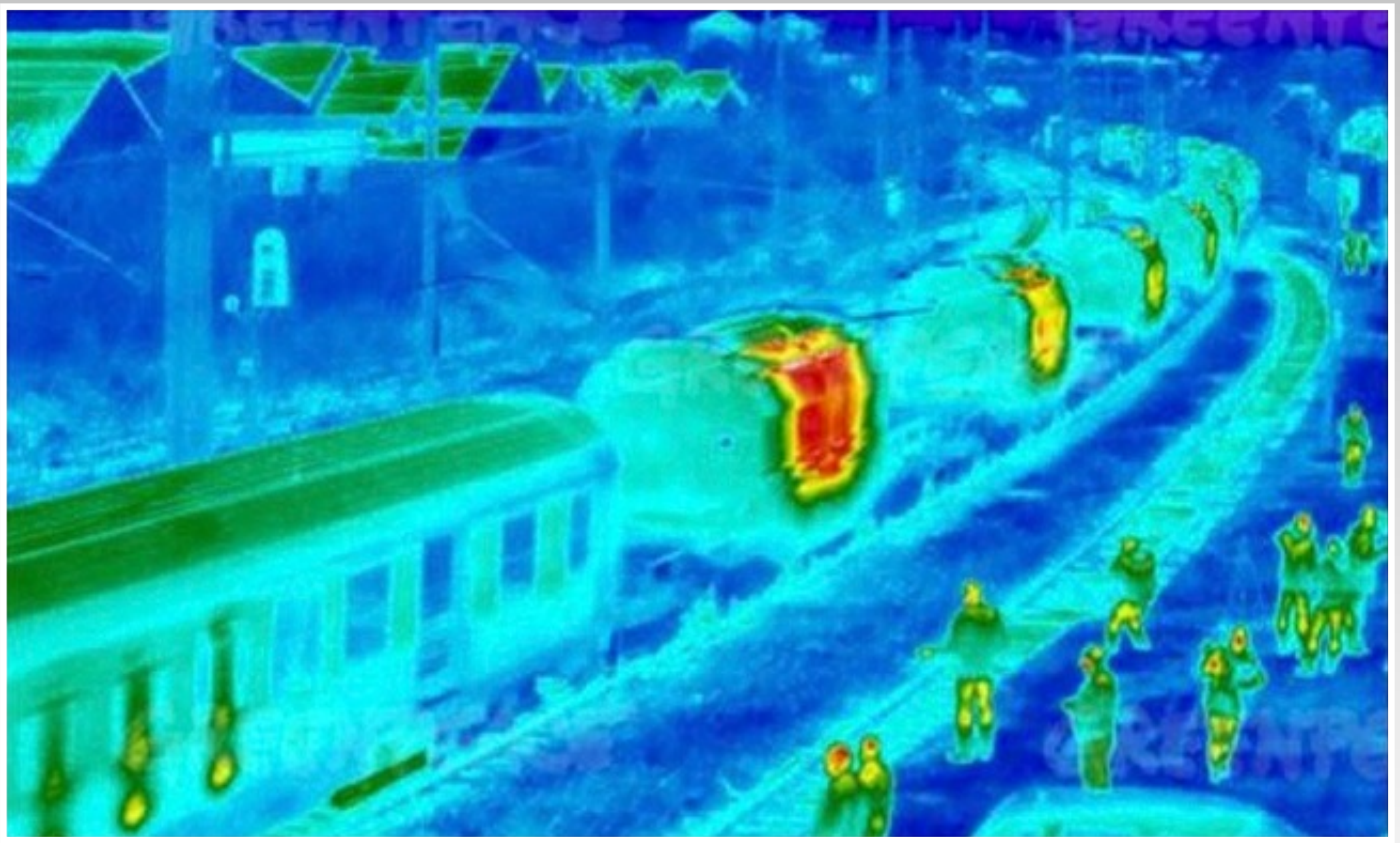
Absence of Clandestine Reprocessing

(Absence of Clandestine Uranium Enrichment)

Airborne Infrared Sensors

to verify shutdown or operational status of existing reactors

(and provide confidence in the absence of undeclared reactors)



Spent fuel transport cask with a power level of 35 kW (thermal)

Estimated surface temperature 30 °C compared to 20 °C of the passenger car on the left. *Source: Greenpeace*

Summary and Conclusion

Building Blocks for a Nuclear Weapon Free Zone in the Middle East

Given the political turmoil in the Middle East, it is unlikely that a ME NWFZ can be established anytime soon; but elements can be put in place

Building Blocks to Lay the Basis for a ME NWFZ

(Ban on plutonium separation; Restrictions on uranium enrichment; Declarations)

Need not be sequenced
Nonproliferation and disarmament values in their own right
States should be encouraged to adopt them as as soon as they are able to do so

Capacity Building for Verification of a NWFZ in the Middle East

Can the Safeguards Community help facilitate discussions and offer fresh ideas?