

# Our Nuclear Age



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# Our Nuclear Age - Overview

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- Part I - Historical perspective
  
  
  
  
  
  
  
  
  
  
- Part II - Issues



## Part I – A closer look at some events

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- Eisenhower and "Atoms for Peace"
- The "Cuban Missile Crisis"
- The NATO dual-track strategy
- The Three Mile Island Accident
- The Chernobyl Accident



## Part II - Issues

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- Nuclear energy
  - Risk of Accidents
  - Waste
  - Limited Fuel
  - Role in the Energy Market
  - Alternatives
  
- The Non-proliferation treaty (NPT)
- The NPT and the role of the IAEA
- Deterrence and Peace
- Current US foreign policy
- Power in the international policy regime
- India–Pakistan, Israel, N. Korea, Iran



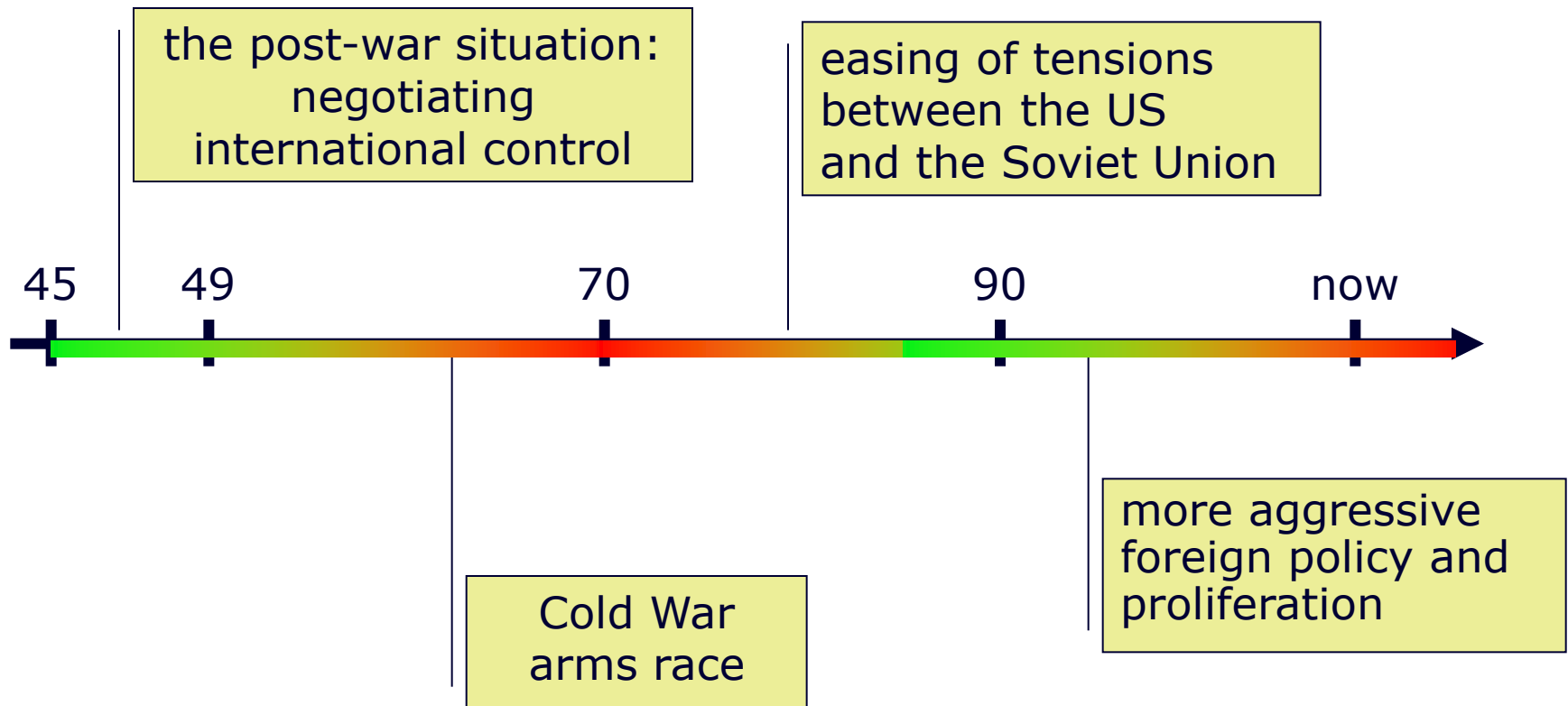
# Part I – Historical Perspective

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- 1945 – 1949 : the post-war situation - negotiating international control
- 1949 – early 1970s : cold war arms race
- 1970 – 1989 : easing of tensions between the US and Soviet Union
- early 90s – now : more aggressive foreign policy and proliferation

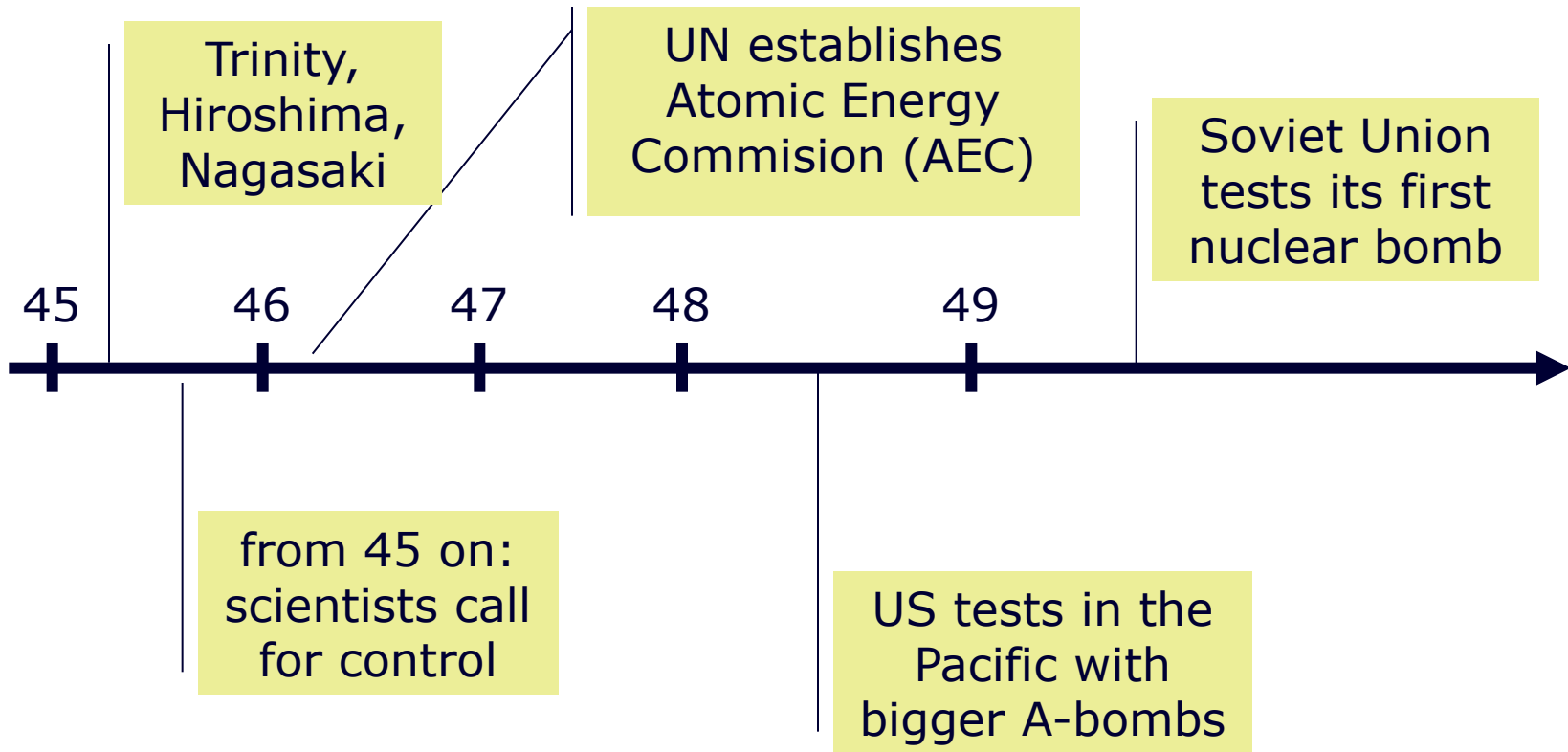
# Historical Perspective - Overview

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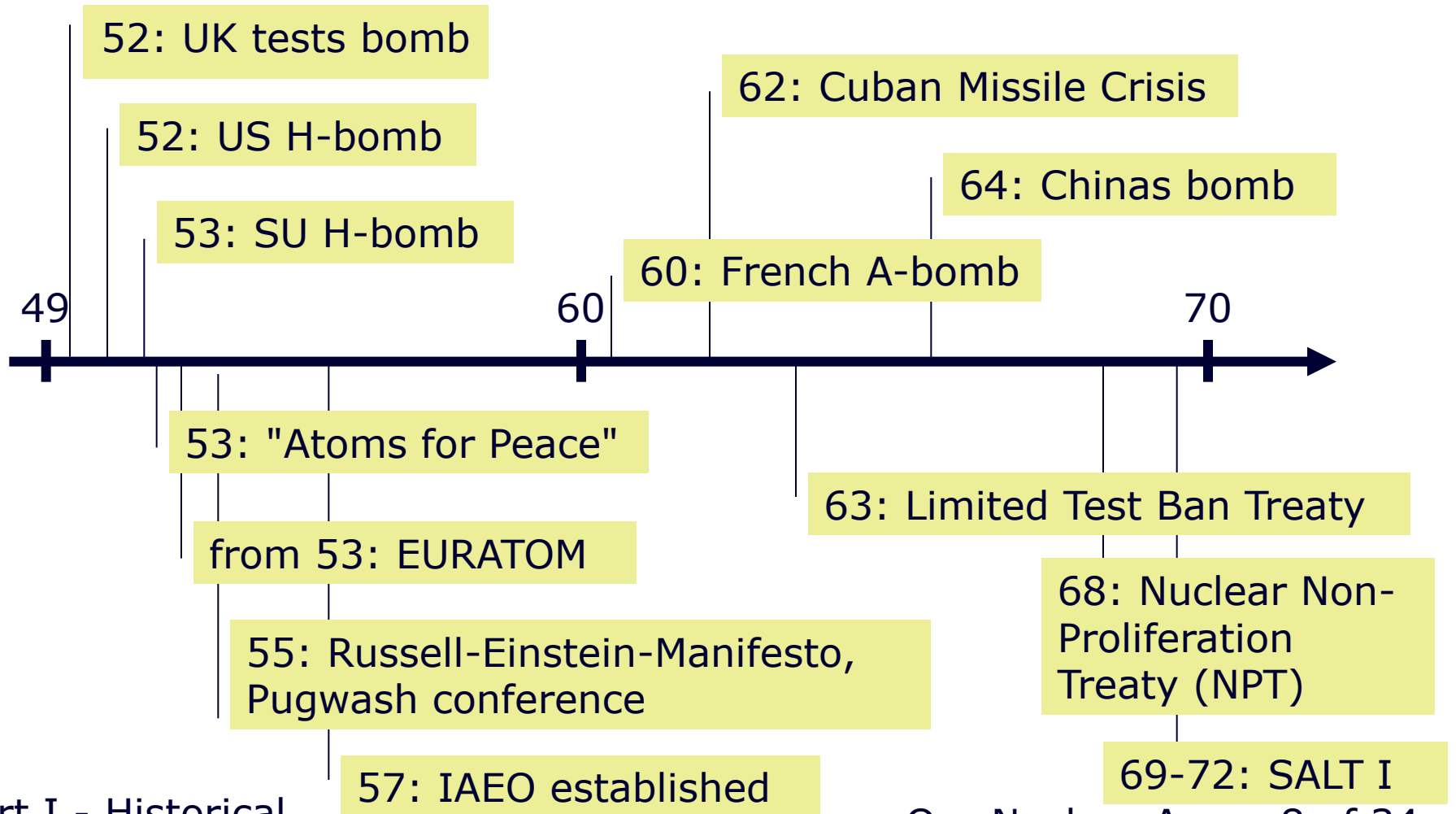


# Trying to negotiate control in the post-war situation

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# Cold War arms race







# Eisenhower, "Atoms for Peace"

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- Operation „Candid“: Threats of thermonuclear warfare
- Eisenhowers speech at UN 1953: Peaceful use of the Atom, "nuclear bank" with "donations" of fissible material by US and Soviet Union
- Lead to creation of US atomic energy program, IAEO, Euratom
- Eisenhowers vision: good, but naive (?)

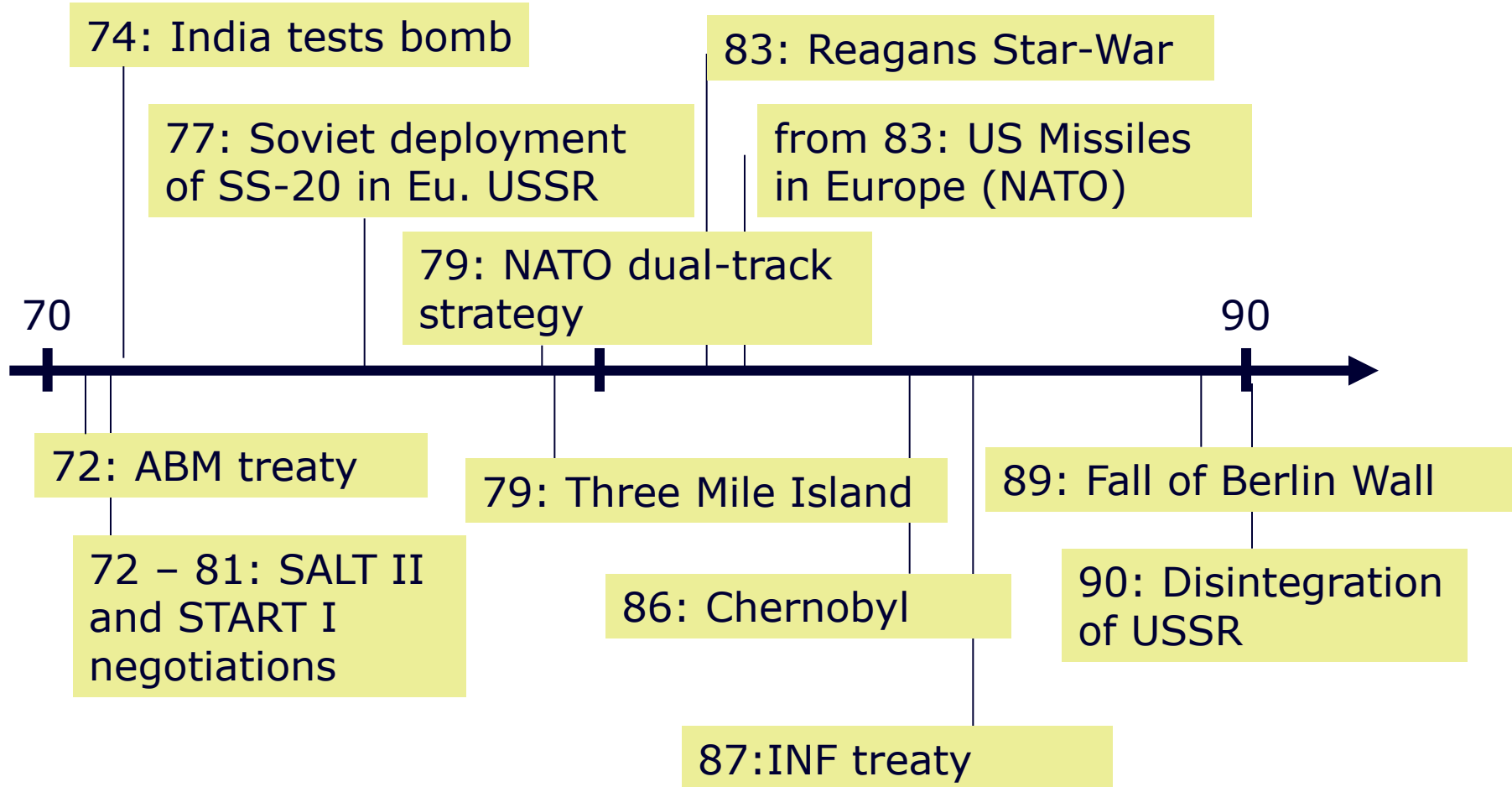
# The "Cuban Missile Crisis"

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- ❑ SU behind U.S. in arms race, SU missiles reach only Europe
- ❑ October 1962: US reconnaissance discovers missile installations in Cuba
- ❑ U.S. President Kennedy orders naval blockade, despite being urged for air strikes or invasion
- ❑ in response Soviet commanders are authorized to launch nuclear weapons if invaded
- ❑ after seven days, Khrushchev gives in  
=> *the world very close to nuclear war*



# Easing of tension





# The NATO dual-track strategy

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- 1977: Deployment of medium range SS20 missiles (,tactical` weapons) in European USSR
- 1979: Soviet invasion of Afghanistan
  
- NATO's response: ,dual-track` strategy
  - offer the Warsaw Pact treaty on tactical weapons reduction
  - if no successful negotiations: US tactical NW deployment in Europe
  
- deployment of NATO missiles in Europe 1983 lead to the most dangerous situation of the Cold War

# The Three Mile Island Accident

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- ❑ March 1979 partial core melt in a nuclear power station at TMI, Pennsylvania, U.S.
- ❑ after five days reactor under control, little radioactivity set free
- ❑ worst nuclear accident in U.S. history
- ❑ support for nuclear power in the U.S. fell from 70% to 50%



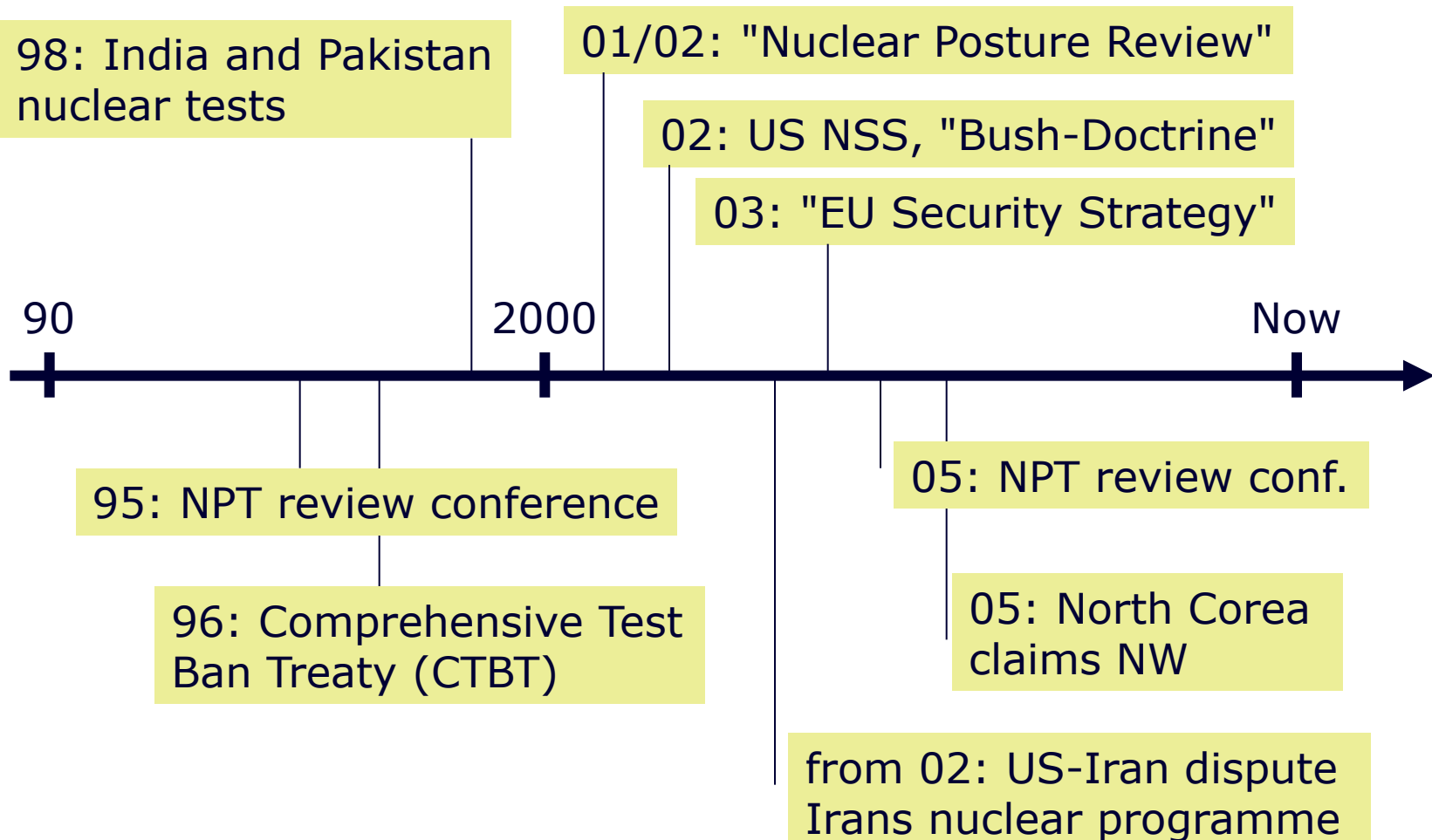


# The Chernobyl Accident

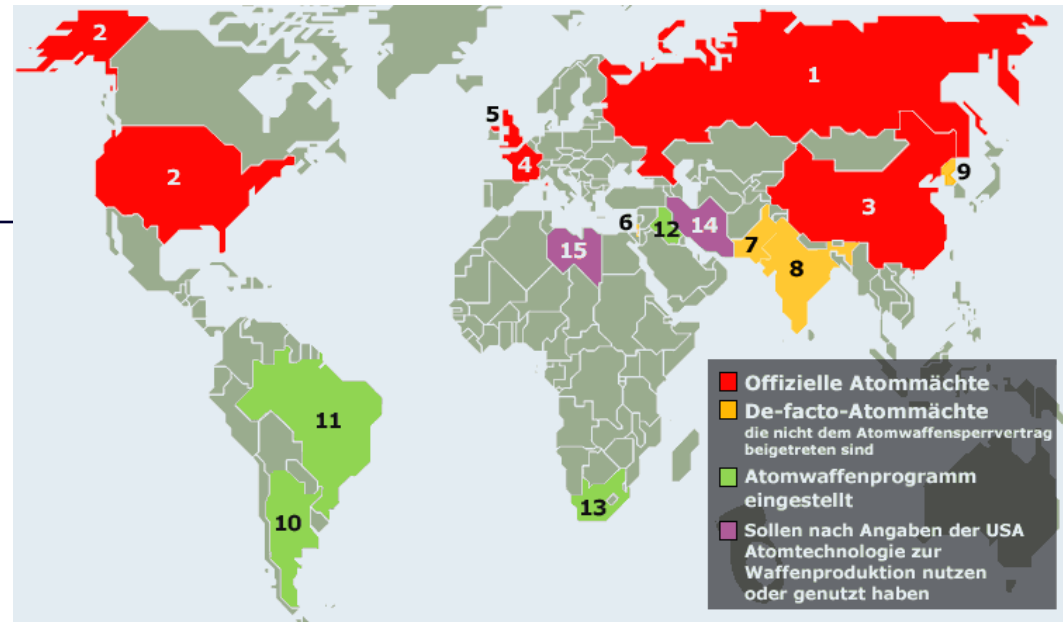
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- April 26, 1968 core melt and explosion in a nuclear power plant at Chernobyl (Ukraine)
- causes: flawed reactor design and human failure
- worst nuclear accident so far: > 350.000 people relocated, ~4000 (?) dead, world wide contamination, financial damage
- outcome as well: reactor safety, concerns about safety of nuclear energy in general

# New threats, aggressive US policy



# Today



**Red:** Official NWS

**Yellow:** De-Facto-NWS

**Green:** Military Nuclear programme discontinued

**Purple:** According to U.S. active Military Nuclear programme

Staaten im Besitz von Kernwaffen

	Nukleare Sprengsätze	Sprengsatz-Produktion insgesamt
Quelle: Center for Defense Information (CDI), Mitte 2004	Quelle: CDI und Sipri, Sprengsätze Anzahl 2003	
1	<b>Russland</b> ca. 9000	55.000 - seit 1949 (UdSSR/Russland)
2	<b>USA</b> ca. 7500	70.000 - seit 1945
3	<b>China</b> ca. 400	600 - seit 1964
4	<b>Frankreich</b> ca. 350	1300 - seit 1964
5	<b>Großbritannien</b> 185	1200 - seit 1953
6	<b>Israel</b> über 200	seit ca. 1967
7	<b>Pakistan</b> 24 - 48	seit 1998
8	<b>Indien</b> über 60	seit 1998
9	<b>Nordkorea</b> mind. 1 bis 2	Material für bis zu 9 - seit 2005
10	<b>Argentinien</b>	
11	<b>Brasilien</b>	
12	<b>Irak</b>	
13	<b>Südafrika</b>	
14	<b>Iran</b>	
15	<b>Libyen</b> (hat sein Atomprogramm offiziell eingestellt und lässt Uno-Inspektoren ins Land)	





# Part II - Issues

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  - Waste
  - Limited Fuel
  - Role in the Energy Market
  - Alternatives
  
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# Nuclear Energy: Risk of Accidents

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- 3 big accidents (core melt) so far: Windscale, TMI, Chernobyl
  
- Super-GAU probability
  - 0.1%/40 years
  - EU (140 reactors): 16%
  - World: (440 reactors): 40%
  
  - but: making absolute statements with probabilities is only possible on a large ensemble!
  
- cost: 5400 bill. € (Prognos AG), insurance cover: 2.5 bill. €
  
- smaller accidents occur daily; leukaemia around reactors

# Policy: Internalizing costs

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- internalize costs of accidents into energy price, e.g. taxation
  - nuclear electricity production: 2660441 GWh/yr
  - 40 years, 440 reactors: 40% accident probability
  - Damage: 5400 bill. €/accident (5400.000.000.000€)
  
  - $E[\text{damage}/40\text{yr}] = 5400 \text{ bill. €} * 0.4 = 2160 \text{ bill. €}$
  - $\Sigma(\text{prod. in } 40\text{yr}) = 2660441 \text{ GWh/yr} * 40 \text{ yr} = 106417640 \text{ GWh}$
  
  - $E[\text{cost}/\text{MWh}] = E[\text{damage}/40\text{yr}] / \Sigma(\text{prod in } 40\text{yr}) = 2160 \text{ bill. €} / 106417640 \text{ GWh} = 20297 \text{ €} / \text{GWh} = \mathbf{0,20 \text{ €}/\text{kWh}}$
  
- RES costs: 2,5c/kWh - 15 c/kWh dep. on technology (Photovoltaics 70c/40c), a large fraction 7 - 8 c/kWh



# Nuclear Energy: Waste

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- There is no safe final waste disposal site
- ~440 reactors produce ~8300t radioactive waste/year
- Reactor waste contains e.g. (weapon capable) Pu-239 with half-life span of 24000 years, others with much longer half-life



# Nuclear Energy: Limited Fuel

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- Global demand: 62000t Uranium/year
- IAEA and NEA (OECD) 1999 report: 1.25 – 4 mill. t ,economically` degradable
- Uranium will last for further 20-65 years with current use (other estimates: 70-90 y)
- "fast breeders" could stretch this period, but have failed to operate economically and safely

# Nuclear Energy: Role in the Energy Market

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- 2001: Atomic energy accounted for only 2,3% of the world energy production, 2653 TWh
- compare: hydroelectric power: 2.2% (2569TWh)
  - sidenote: statistics (graphs) often show 6% for nuclear energy, then raw thermal power of uranium is accounted for, check numbers at <http://www.iea.org>
- but: some Nations depend heavily on nuclear energy (e.g. France with 80%)

# Nuclear Energy: Alternatives

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## Renewable Energy Sources! Example EU:

- additional RES sources to energy production
  - solar thermal power plants in North Africa, European-Mediterranean electricity grid => 10.000TWh/a electricity
  - geothermal resources => 1.700 TWh/a
  - offshore wind converters at the eu cost => 2000 TWh/a
  
- various scenarios show how energy market can evolve
  - "Fair Market" scenario: evolution of the energy market with regard to externalities, e.g. taxation; shows potentials of RES: demand halves, RES account for 80%
  - "Solar Energy Economy (SEE)" scenario, DLR, 2003: RES can generate 50% electricity by 2050
  
- but: without changes in EU energy policy ("baseline" scenario) amount of RES still low in 2050



# Non-Proliferation Treaty (NPT)

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- Nuclear-Weapon states (US, Soviet Union, UK, France, China) and Non-NWS
- non-proliferation, disarmament, right to peacefully use nuclear technology
- IAEA as safeguard
- Openend for signature 1968, in force 1970, 189 states signed





## The NPT (2)

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- 1995 Review Conference: extended for indefinite duration
  
- 2005 Review Conference failed
  - US: focus on non-proliferation (=>Iran)
  - Non-Aligned countries: disarmament
  - Proliferators (e.g. India, Pakistan): end double standard
  
- no disarmament, US-NATO nuclear weapon sharing, planned US exports of nuclear technology to India and US attempt to deny Iran nuclear energy



# NPT, IAEA and proliferation

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- NPT: right to civil nuclear energy in exchange for no NW
  - with assistance through IAEA
  
- IAEA is not intelligence agency
- inspections have to be negotiated ('97 additional protocol)
  
- Violations – what happened ?
  - Iraq '91
  - North Korea '94
  - Iran 05
  
- N. Korea – a precedence case?
- Security situation perceived differently after 90

# Deterrence and Peace

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- **"Strategic deterrence convinces adversaries not to take grievous courses of action by means of decisive influence over their decision making."** (*US Doctrine of Joint Nuclear Operations, March 2005*)
  - *compare Dr. Strangelove...*
  - *but: not only military decision making!*
  
- **Deterrence brought peace ?**
  - **Yes: End of the Korean War**
  - **No: Almost war in two cases**
    - **Cuban Crisis: What if weaker US president or other policy?**
    - **'83 operation "Able Archer"**
  - **No: Proxy Wars**
    - **Afghanistan, Angola, Vietnam etc.**



# Current US foreign policy

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- from deterrence to direct and unilateral action
- 2002: National Security Strategy ("Bush-Doctrine")
  - "no distinction between the terrorists [...] and those who harbor them" (Bush, 01/09)
  - Preemption ("preemptive self-defense")
  - Unilateralism
  - Strength Beyond Challenge
  - Extending Democracy, Liberty, and Security to All Regions
- difference preemption  $\Leftrightarrow$  aggression?
- threat of US first strike (as seen in Iraq) increases importance for NW as self defence for "rogue" states
  - compare: North Korea, Iran (?)

# Power in the international policy regime

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- Security Council consists of Nuclear Weapon States
  
- "The US defense strategy serves the national objective of peace **with prosperity**." *US Doctrine of Joint Nuclear Operations, March 2005, emphasis added*
  - "We are simply asking for fair and equitable rules that would take into account our development needs and allow us to participate fully in the trade system. But instead we risk being pressured once again into accepting rules we don't need and can't afford." *Ambassador Nathan Irumba, Mission of Uganda and Representative of the Least Developed Countries (LDC) at the WTO, about the Doha round of WTO negotiations.*
  - *recommended reading: Aileen Kwa, "Power politics in the WTO", [www.focusweb.org](http://www.focusweb.org)*



# India–Pakistan, Israel

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## □ India-Pakistan

- partition of India by the British in 1947
- Kashmir disputed
- 1998 a-bomb tests by both

## □ Israel

- state created '48 before the end of the British mandate of Palestine
- surrounded by nations not recognizing the State
- built a very strong military force (ref. '67 Six Day War)
- NW with help of the British (reactor)
- strong lobby in the US



# N. Korea, Iran

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## □ Korea

- divided since '45
- '50-'53 Korean War
- 2005: North claims Atomic weapons

## □ Iran

- '53: plot against Mossadeq staged by US/UK intelligence
- '79: islamic revolution
- U.S. claim secret Iranian uranium enrichment programme since 2002 (ref. Iraqs WMD), effectively reversing charge of proof
- Iran seeks complete nuclear fuel cycle since '91



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Remember your humanity, and forget the rest.

*From the "Russell-Einstein-Manifesto"*





# Discussion

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- what is the real role of Nuclear Energy? of Nuclear Weapons?
  
- will North Korea be a precedence case for other countries? Iran?