

EXCEL SERVICES CORPORATION

Nuclear Engineering Consulting



NUCLEAR REGULATIONS – RECENT INTERNATIONAL DEVELOPMENTS

**LICENSE HOLDER FORUM
Sydney/Melbourne
June 16-18, 2015**

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Excel Services Corporation
Previous President
American Nuclear Society (ANS)**





NUCLEAR REGULATIONS – RECENT INTERNATIONAL DEVELOPMENTS

- Latest Developments in all Nuclear Markets**
- Historical International Regulatory Relationships**
- Summary of Key Countries Regulatory Regimes**
- IAEA Support of International Developments**
- Characteristics of a Credible Nuclear Regulator**
- EXCEL Support of International Developments**



International Developments

LATEST DEVELOPMENTS IN ALL NUCLEAR MARKETS



Latest Developments (International)

- **TVO has put OL-4 new build Project on hold, since they cannot meet the June 30, 2015 deadline for CLA submittal**
- **Vattenfall has announced that they will shut down Ringhals-1/2 in 2018/20 (7 years early)**
- **EDF has been asked by the French Government to acquire the reactor business from AREVA**



Latest Developments (2) (International)

- **Japan**: 43 reactors are “operable” and 24 of them are in the “restart approval” process
- **UK**: CGN (China) applies for GDA process in 2016 for Bradwell, based on Hualong-1 design (“merger” of AP1000 and CPR1000)
- **USA**: 5 Plants under Construction (Watts Bar-2, Vogtle-3/4 and VC Summer-2/3). Economic issues holding back others.



Latest Developments (3) (Australia)

- On March 19, 2015 South Australia (SA) started the Royal Commission looking into Nuclear Option for 2030-50 time frame.**
- The Final Report is expected in May 2016.**
- Currently Power Plants in SA are limited to 260 MWe (due to Grid) – future max 500 MWe.**
- This suggest a possible “entry point” for SMRs into Australia in future, since SA already produces 2/3 of Australia’s uranium.**

Current NPP Constructions

excluding domestic Chinese, Indian Vendors

Vendor	Plant	Type	COD	Status
AREVA	Angra 3	Gen II Konvoi PWR	2016	Under construction, restarted after 23 years
AREVA	Flamanville 3	EPR1600	6/16	Under construction, 6 yrs delay
AREVA	Olkiluoto 3	EPR1600	6/16	Under construction, 7 yrs delay
AREVA	Taishan 1	EPR1700	12/13	Under construction
AREVA	Taishan 2	EPR1700	11/14	Under construction
AREVA/Mitsubishi	Sinop-1/2/3/4	ATMEA1	?	Under contract; first ATMEA contract (BOT)
ASE	Kundankulam 2	VVER1000	6/14	Under construction, near startup, 5 years delay
ASE	Leningrad 2-1	VVER1200	2014	Under construction
ASE	Leningrad 2-2	VVER1200	2016	Under construction
ASE	Mochovce 3	VVER 440	2014	Under construction, near startup
ASE	Mochovce 4	VVER 440	2015	Under construction, near startup
ASE	Novovoronezh 2-1	VVER1200	2014	Under construction
ASE	Novovoronezh 2-2	VVER1200	2015	Under construction
ASE	Rostov 3	VVER1000	2015	Under construction
ASE	Rostov 4	VVER1000	2017	Under construction
ASE	Tianwan 3	VVER1000/AES91-428	2017	Under construction
ASE	Tianwan 4	VVER1000/AES91-428	2018	Under construction
ASE	Akkuyu-1/2/3/4	VVER1200	2020-26	Under contract; first BOO Contract
ASE	Bushar-2/3	VVER1200	2023-	Under contract
ASE	Paks-5/6	VVER1200	2023-	Under contract
ASE	Kaliningrad-1 (Baltic-1)	VVER1200	2016	Under construction; halted/mothballed

Current NPP Constructions (2)

excluding domestic Chinese, Indian Vendors

Vendor	Plant	Type	COD	Status
ASEA	Hanhikivi-1 (Finland)	VVER1200	2023	Under contract
ASE	Armenia-3	VVER1000 (V392)	2026	Under construction
ASE	Ostrovets-1 (Belarus)	VVER1200 (V491)	2019	Under construction
ASE	Ostrovets-2 (Belarus)	VVER1200 (V491)	2020	Under construction
Candu Energy/CGN	Cernavoda-3/4	CANDU-6	2023-	Under contract (Chinese financing)
GE-H	Lungmen 1	ABWR	2013	Under construction, near startup, 10 years delay
GE-H	Lungmen 2	ABWR	2014	Under construction, near startup, 10 years delay
Hitachi	Ohma	ABWR	2016	Under construction (1 st restart after Fukushima)
Hitachi	Shimane 3	ABWR	12/13	Under construction (on hold), near startup
KHNP	Shin Kori 3	APR1400	1/14	Under construction
KHNP	Shin Kori 4	APR1400	9/14	Under construction
KHNP	Shin Kori 5	APR1400	12/18	Under contract
KHNP	Shin Kori 6	APR1400	12/19	Under contract
KHNP	Shin Ulchin 1	APR1400	4/17	Under construction
KHNP	Shin Ulchin 2	APR1400	2/18	Under construction
KHNP	Shin Wolsong 2	Gen II OPR1000	1/14	Under construction; delayed
KHNP	UAE-1	APR1400	6/17	Under construction
KHNP	UAE-2	APR1400	6/18	Under construction
KHNP	UAE-3	APR1400	6/19	2010 contract
KHNP	UAE-4	APR1400	6/20	2010 contract
Mitsubishi	Tsuruga 3	APWR1538	3/16	Under construction, on hold
Mitsubishi	Tsuruga 4	APWR1538	3/17	Under construction, on hold

Current NPP Constructions (3)

excluding domestic Chinese, Indian Vendors

Vendor	Plant	Type	COD	Status
Mitsubishi	Comanche Peak 3	APWR1700	?	Firm plans, waiting on EPC Contract, COL
Mitsubishi	Comanche Peak 4	APWR1700	?	Firm plans, waiting on EPC Contract, COL
Toshiba	Higashi Dori 1 (TEPCO)	ABWR	3/17	Under contract, on hold
Westinghouse	Haiyang 1	AP1000	5/14	Under construction
Westinghouse	Haiyang 2	AP1000	3/15	Under construction
Westinghouse	Sanmen 1	AP1000	11/13	Under construction
Westinghouse	Sanmen 2	AP1000	9/14	Under construction
Westinghouse	Vogtle 3	AP1000	2018	Under construction
Westinghouse	Vogtle 4	AP1000	2019	Under construction
Westinghouse	Summer 2	AP1000	2018	Under construction
Westinghouse	Summer 3	AP1000	2019	Under construction
Westinghouse	Watts Bar 2	Gen II PWR 1100	2016	Under construction, restarted after 20 years

CHINA – Mega New Build Market

Source: WNA Country Briefing – China, 2015

	Province	MWe gross	Reactor model	Project control	Construction start	Operation
Hongyanhe-4	Liaoning	1119	CPR-1000	CGN, with CPI	8/09	late 2015
Ningde-4	Fujian	1089	CPR-1000	CGN, with Datang	9/10	early 2016
Fuqing-2	Fujian	1087	CPR-1000 (M310+)	CNNC, with Huadian	6/09	2015
Yangjiang 3&4	Guangdong	2x1089	CPR-1000+	CGN	11/10, 11/12	2015, 2017
Sanmen 1&2	Zhejiang	2x1250	AP1000	CNNC	3/09, 12/09	2016, 2017
Haiyang 1&2	Shandong	2x1250	AP1000	CPI	9/09, 6/10	12/2015, 3/16
Taishan 1&2	Guangdong	2x1750	EPR	CGN	10/09, 4/10	late 2016, 2017
Shandong Shidaowan	Shandong	210	HTR-PM	Huaneng	12/12	2017
Fangchenggang-1&2	Guangxi	2x1080	CPR-1000	CGN	7/10, 2011	3/2015, 2016
Changjiang-1&2	Hainan	2x650	CNP-600	CNNC & Huaneng	4/10, 11/10	2015, 12/2015
Fuqing-3&4	Fujian	2x1080	CPR-1000 (M310+)	CNNC & Huadian	12/10, 11/12	late 2015, 2017
Tianwan-3&4	Jiangsu	2x1060	VVER-1000 V-428M	CNNC	12/12, 9/13	2/2016, 3/2017

CHINA – Mega New Build Market (2)

Source: WNA Country Briefing – China, 2015

	Province	MWe gross	Reactor model	Project control	Construction start	Operation
Yangjiang-5&6	Guangdong	2x1080	ACPR1000	CGN	9/13, 12/13	2018, 2019
Hongyanhe-5&6	Liaoning	2x1080	ACPR1000	CGN, with CPI	3/15, 2016*	11/2019, 8/2020
Shidaowan -1&2	Shandong	2x1400	CAP1400	SNPTC & Huaneng	5/15, 8/2015	12/2019, 2020
Fuqing-5&6	Fujian	2x1150	Hualong 1	CNNC & Huadian	5/15, 2015*	2019, 2020
Fangchenggang-3&4	Guangxi	2x1150	Hualong 1	CGN	late 2015*	
Ningde-5&6	Fujian	2x1150	Hualong 1	CGN & Datang	2015-17*	
Xudabao/Xudapu-1&2	Liaoning	2x1250	AP1000	CNNC, Datang	2015-16*	2019, 2020
Sanmen-3/4	Zhejiang	2x1250	AP1000	CNNC	2015-16*	

CHINA – Mega New Build Market (3)

Source: WNA Country Briefing – China, 2015

	Province	MWe gross	Reactor model	Project control	Construction start	Operation
Haiyang-3&4	Shandong	2x1250	AP1000	CPI	2015-16*	
Lufeng (Shanwei)-1&2	Guangdong	2x1250	AP1000	CGN	2015-16*	2019, 2020
Fangchenggang-5&6	Guangxi	2x1250	AP1000	CGN	2015-17	
Bailong-1&2	Guangxi	2x1250	AP1000	CPI	2015-17	
Huizhou-1&2	Guangdong	2x1250	AP1000	CGN	2015-18	
Putian, Zhangzhou-1&2	Fujian	2x100	ACP100	CNNC & Guodian	2015	2017
Tianwan-5&6	Jiangsu	2x1080	ACPR1000	CNNC	2016-17	

CHINA – Mega New Build Market (4)

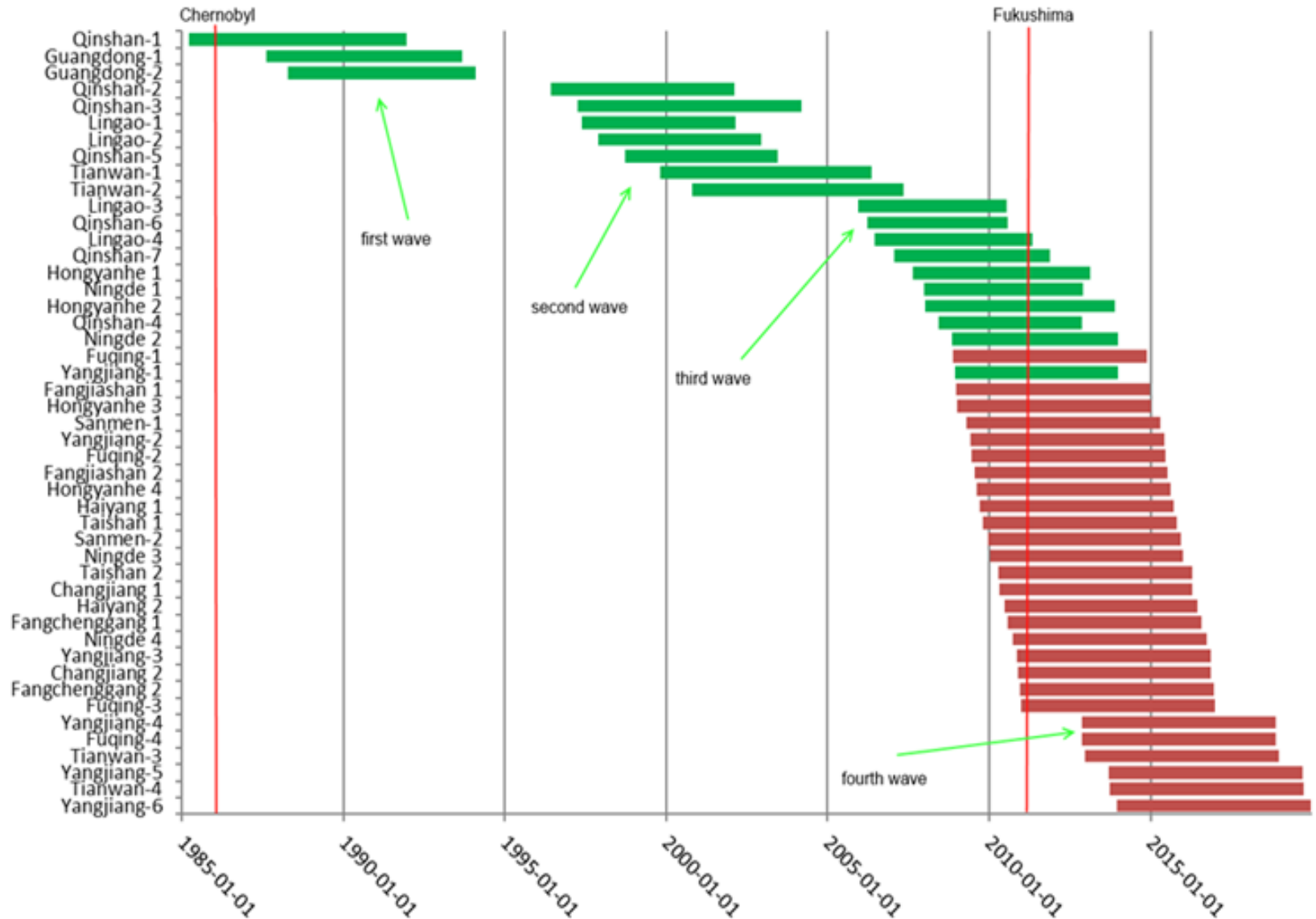
Source: WNA Country Briefing – China, 2015

	Province	MWe gross	Reactor model	Project control	Construction start	Operation
Taishan-3&4	Guangdong	2x1750	EPR	CGN	2015-18	
Changjiang-3&4	Hainan	2x650	CNP-650 or ACP-600	CNNC & Huaneng	2015-18	
Zhangzhou-1-4	Fujian	4x1250	AP1000	Guodian & CNNC	2016	
Sanming -1&2	Fujian	2x880	BN-800?	CNNC	?	2025?
Taohuajiang-1-4	Hunan (inland)	4x1250	AP1000	CNNC	2016 -18*	
Pengze-1&2	Jiangxi (inland)	2x1250	AP1000	CPI	2016-17*	
Xianning (Dafan)-1&2	Hubei (inland)	2x1250	AP1000	CGN	2016-17*	

Total: 68 (24 Under construction 36 + 8 Planned)

CHINA – Mega New Build Market (5)

Source: WNA Country Briefing – China, 2015





SMRs under Construction

Source: WNA – Country Briefing

CHINA

Demonstration HTR-PM: (Shidaowan-1/2), using German Pebble-Bed concept

2x105 MWe reactor units driving a single 210 MWe Turbine

EPC contract placed 10/2008, site work completed

Construction start – mid 2011. Startup planned 2017

ACP100: Small Modular Integral PWR (shipped as one unit)
120,000 m³ per day desalination/module

CNNC & Guodian is building (2) Demo Units at Zhangzhou

Cost of these first (2) Units is ~\$800 Million

Construction start 2015, operation in 2018

57 PWR fuel assemblies, 7ft active length; Integral Steam

Generators. Integral PWR/passive design underground. 60 years design life, 24 months refueling.



SMRs under Construction (2)

Source: WNA – Country Briefing

ARGENTINA

Prototype CAREMA-25: (27 MWe) PWR under construction
Fuel loading in 2017. Total cost \$450 Million.

SAUDI ARABIA

In March 2015 KAERI/South Korea and KA-CARE signed
agreement for Feasibility of 2xSMART (100 Mwe, ~1 Billion/Unit)



Research Reactor under Construction

Source: WNA – Country Briefing

Jordan:

- In 2009 ordered a 5 MWe Research Reactor from KAERI
- It is called JRTR
- Total cost \$173 Million
- Startup in 2018?
- Copy of the Korean HANARO reactor (19% U235)
- Based on Canadian Maple-1/2 design (built but never operated)



MAJOR CHANGES POST FUKUSHIMA

- Every NPP in every country was “safety-analyzed” again
- Practically every NPP was found in need of some improvements:
 - Increased “Reliability” of Emergency Power supply, means adding extra Diesel Generators
 - Additional Redundancies in important systems
 - Additional extra/independent cooling system for Spent Fuel Pool
 - Backfitting extra/independent core cooling system in existing plants by 2020 (Sweden)



MAJOR CHANGES POST FUKUSHIMA (2)

- Performing new Seismic Analyses for many NPPs, resulting in requirements for additional seismic protection
- Reviewing the Flooding risks, and adding Tsunami protection walls (Japan)
- Reviewing Flooding risks from upstream Dam failures
- Performing refined PRA analyses
- Central Rapid Response Centers (USA, China, Russia)
- Improved Emergency Planning (and Training)
- Mitigation against multiple initiation events, and planning / protection against multi-Unit events



OTHER RECENT TRENDS – RISK INFORMED REGULATIONS

- US NRC is reworking its NUREGs to introduce „risk-informed“ Regulations that improve safety levels
- Detailed PRA analyses need to be performed
- Example: Finnish Authority (STUK) requires
 - that each system design (in NSSS) needs to be „tested“ in a Full-scale hi-fidelity Plant Simulator before it can be approved/licensed
 - FAC testing includes that each Cabinet needs to be tested by „hooking“ it up to a full-scale Plant Simulator model (run on Laptop) and many possible „faults“ are tested before it can be approved



Nuclear Regulations – International Developments

HISTORICAL INTERNATIONAL RELATIONSHIPS

- Overview of Major Trends in Past 15 Years**
- Nuclear Regulations**
- Nuclear Codes and Standards**



Nuclear Regulations – International Developments

Overview of major Trends in past 15 years

- **Period up to Fukushima:**

- Focus was on “Harmonization” of international Nuclear Regulations as well as Nuclear Codes and Standards
- USNRC (MDEP Program) and WNA worked towards this “long-term “ goal (international Airline Industry Licensing is example)
- Some progress was made between 2000 and 2011
- Goal was to reduce time & costs for licensing of new build NPPs

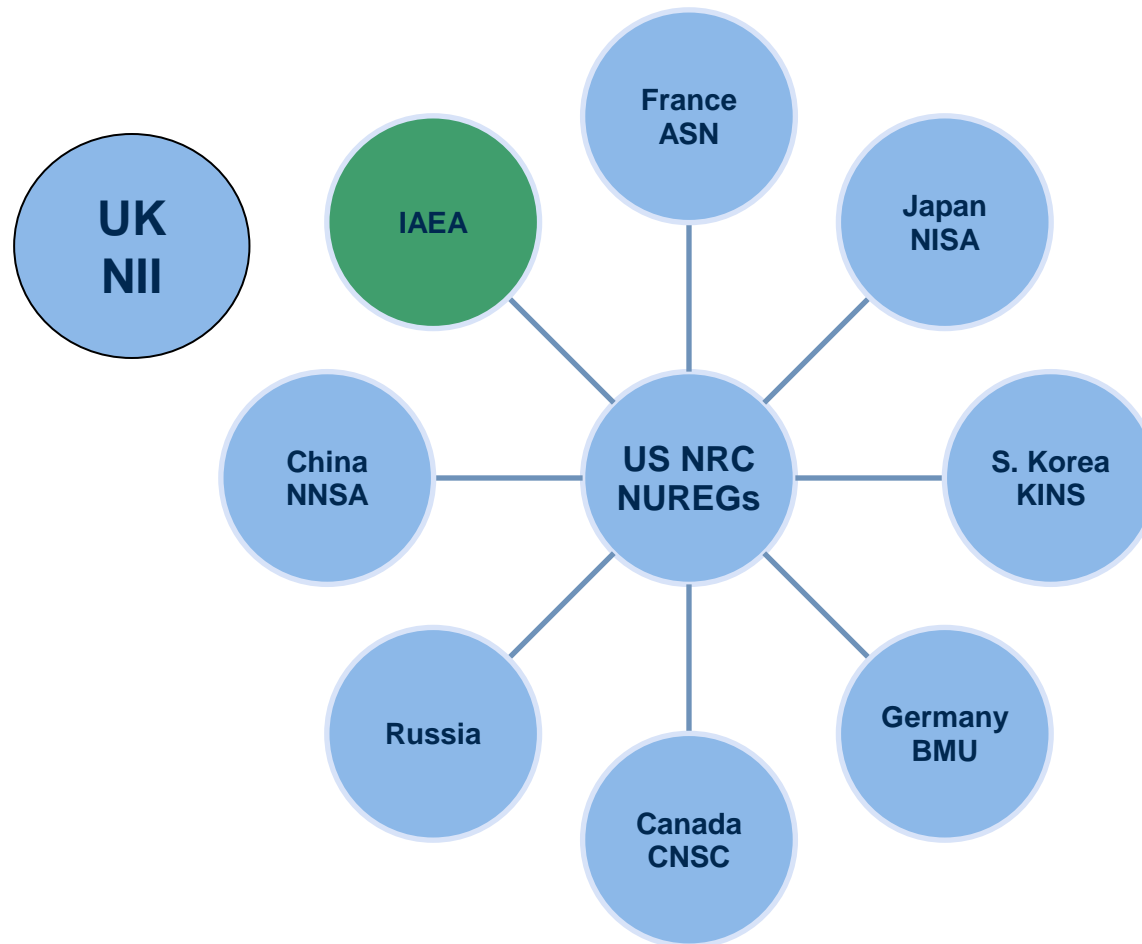


Nuclear Regulations – International Developments (2)

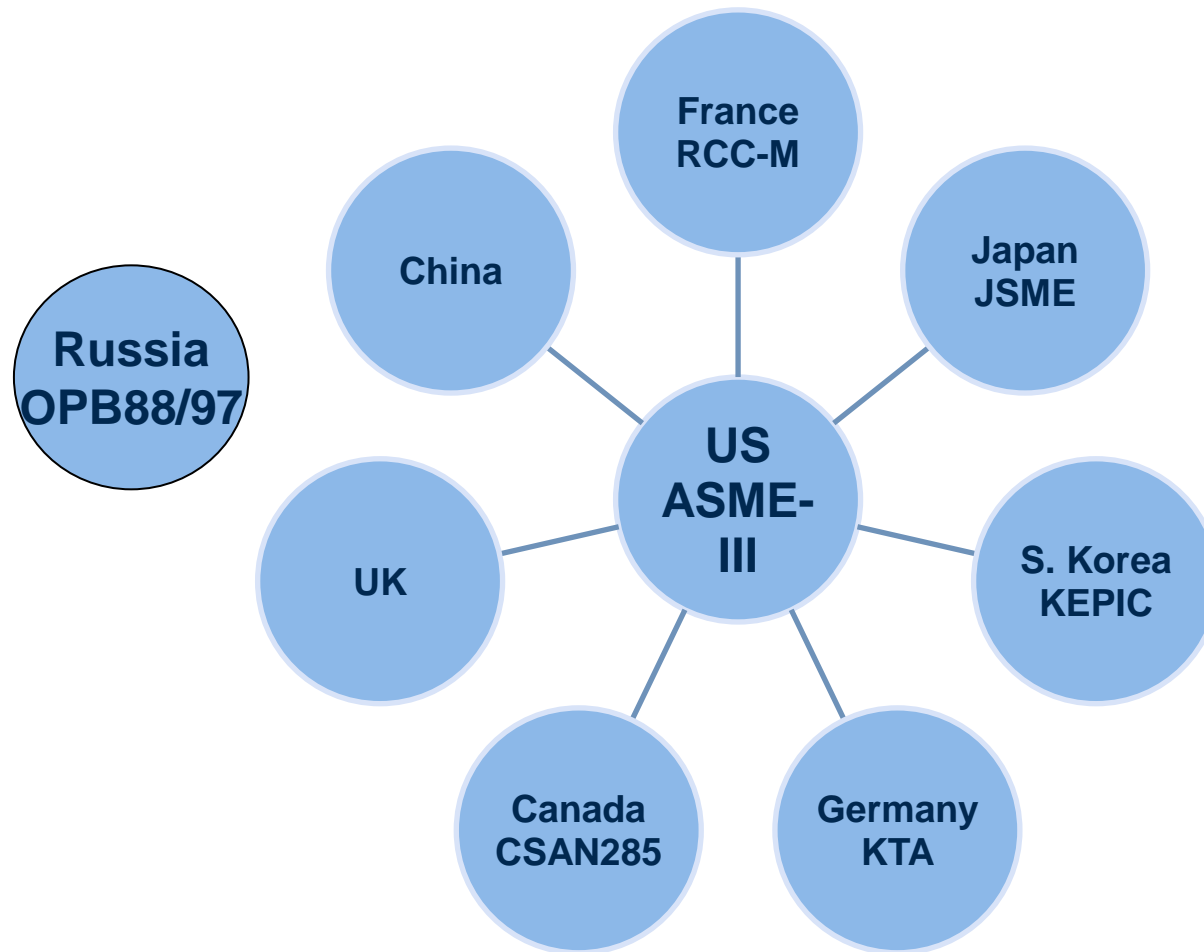
Overview of major Trends in past 15 years

- **Fukushima presents new opportunities to “harmonize” Nuclear Regulations worldwide:**
 - Japan has established a new Regulator (NRA)
 - NRA is re-writing the Japanese Nuclear Regulations (which now tend to become closer to International and USNRC Regulations)
 - Post-Fukushima “safety upgrades” of existing NPPs worldwide also create pressure towards similar design improvements and requirements worldwide
 - Once the immediate urgency of safety upgrades is over – this trend will have helped “harmonization” to move forward

Nuclear Regulations – Historic International Regulatory Relationships



Nuclear Codes & Standards – Historic International Standards Relationships





Nuclear Regulations – International Developments

SUMMARY OF KEY COUNTRIES:

- Nuclear Regulations**
- Nuclear Codes and Standards**

Proven Nuclear Regulations for New Build

Country	Regulator, Regulatory Guides	Usefulness for Emerging Countries
USA	USNRC, NUREGs	MOST COMPLETE set. Available for Download. For most Newcomer countries a "Subset" is sufficient (FANR is a good example of this approach).
Finland	STUK, YVL-Guides	MOST COMPACT set based on USNRC plus some extra conservatism (BEST OPTION for download). In 2014 an even more compact/updated set of 35 YVL Guides was issued, incorporating the Lessons Learned from OL-3.
France	ASN	No complete/consistent set of ASN Guides exists yet (work in progress). No possibility to download a complete useful set.
South Korea	KINS	No useful download exists.
Japan	NISA	No useful download exists. Fukushima caused reorganization and re-writing (now closer to NRC).
Russia		No useful download set of Russian NUREGs exists.
IAEA	IAEA Safety Series	GOOD OPTION for download – but this is not a set of nuclear regulatory requirements – only a generic guidance, but useful as a minimum standard.

Nuclear Codes and Standards

Country	NPP Licensing	Regulatory Guides	Quality Assurance Code	Nuclear Piping and Pressure Vessel Code
Canada	2-step	CSA - CANDU No ALWR Reg Guides	CSA N286 series (based on ASME NQA-1, ISO9001) IAEA-50-C/SG-Q (off-shore)	CSA N285 series (ASME)
China	2-step	HAFs	IAEA-50-C/SG-Q	Country of origin
Finland	2-step	STUK YVLs (similar to NRC Reg Guides, more conservative)	IAEA-50-C/SG-Q, ASME NQA-1, ISO9001:2000	In future only ASME III RCC-M (by exception only)
France	2-step	New French Law TSN Act June 13, 2006). <u>However, no consistent set of French Reg Guides are published.</u> Directives available in French are based on French, US and EU Regulations.	NCA 4000 IAEA-50-C/SG-Q, ASME NQA-1, ISO9001:2000 KTA1401. 9/28/2008: ASN published License Conditions for design and Construction of Flamanville-3.	ASME III until 1984 (first 30 PWRs), succeeded by RCC-M (= ASME-1978 plus about 1000 changes, <u>but w/o independent 3rd party Inspectors as requested as a cornerstone in ASME.</u>

Nuclear Codes and Standards (2)

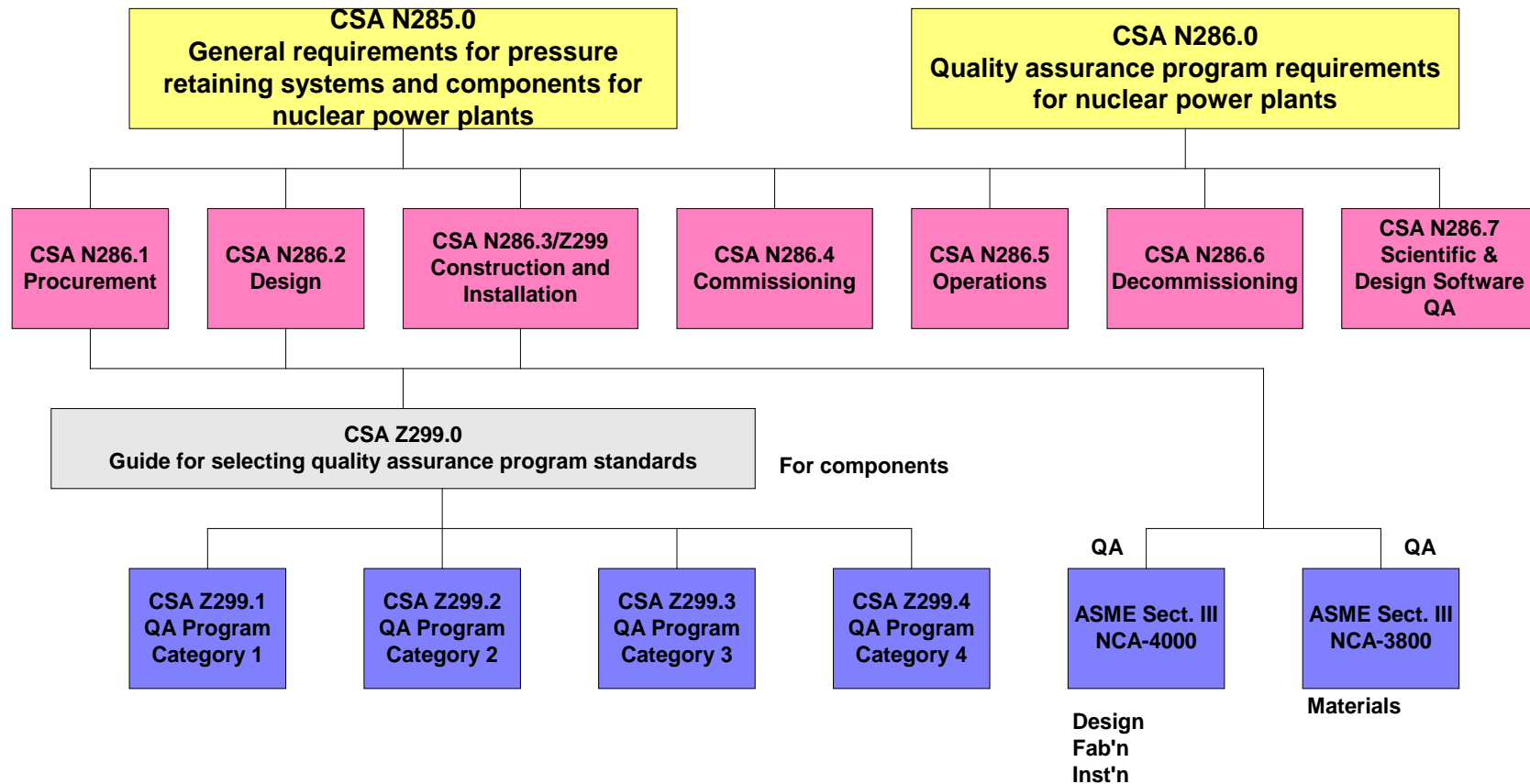
Country	NPP Licensing	Regulatory Guides	Quality Assurance Code	Nuclear Piping and Pressure Vessel Code
IAEA	<u>Not a Licensing Structure</u>	Covern all areas like US NRC Guides	GS-R-3 replaces IAEA-50-C/SG-Q and aligns with ISO9001:2000	<u>Only recommendations</u> , which means IAEA provides <u>not</u> a complete Licensing Structure
Japan (under revision)	2-step	JEAGs JEAG-4121 (QA)	JEAC 4111 (IAEA-50-C/SG-Q, NQA-1, ISO9001)	JSME (ASME, but no 3 rd party inspections). <u>Post-Fukushima entire regulatory structure is changed/re-written.</u>
Russia	1-step	OPB-88/97	IAEA 1994 evaluation showed OPB-88/97 to be essentially similar to IAEA NUSS Program	n/a
S. Korea	2-step	KINS	ASME NQA-1 w/local accreditation system and ISO9001 for non-nuclear plant portion	KEPIC (= ASME) for off-shore and domestic new build Gen-III/III+ plants. Country of origin for existing domestic fleet
USA	1-step (COL) 2- step	NRC Reg Guides	10CFR50 App B ASME NQA-1	ASME III



CANADA – Nuclear Regulations

- CSA N285.0 series provides requirements for design, procurement, fabrication, installation, modification, repair, replacement, testing, examination, and inspection of, and other work related to, pressure-retaining and containment systems, components, and supports over the service life of a CANDU
- IAEA 50-C/SG-Q
- CSA N286 series (QA standards)
- CSA N285 series / ASME Section III
- NCA-3800,-4000
- 10 CFR 50 APP. B
- ASME NQA-01
- Regulatory standards (CNSC)

CANADA – Nuclear Regulations (2)



Relationship of Canadian Quality Assurance Standards



CHINA – Nuclear Regulations

- China Atomic Energy Authority (CAEA) is responsible for planning and managing the civilian nuclear energy program
- The National Nuclear Safety Administration (NNSA) is the licensing and regulatory body, which also maintains international agreements regarding safety
- May 2007 MOU between NNSA / US NRC regarding AP1000
- Regulations and Codes largely based on country of origin:
 - Canadian - CANDU
 - French – PWR, EPR
 - Russian – VVER1000
 - U.S. – AP1000
- Chinese HAF Guides for QA (based on IAEA 50-C/SG-Q)
- **New post-Fukushima Regulatory Requirements**

CHINA – Fukushima Response

Inspection/Review Category	Inspection/Review Area	EXCEL Capability
EXTERNAL EVENTS	Adequacy review of Site selection process	✓
	Capability of flood protection & control	✓
	Seismic capability/margins of NPP designs	✓
	Capability of fire protection system	✓
	Mitigation against multiple natural events	✓
SEVERE ACCIDENT	SBO - availability of additional power supplies	✓
	Reliability of SA mitigation & counter measures	✓
EMERGENCY MANAGEMENT	Planning for massive disruption event	✓
	Effectiveness of monitoring & emergency response	✓
PROJECT MANAGEMENT	QA plan for construction, installation & pre-op tests	✓
	Project Management & Process control of construction	✓
	Other potential weaknesses to be identified	✓

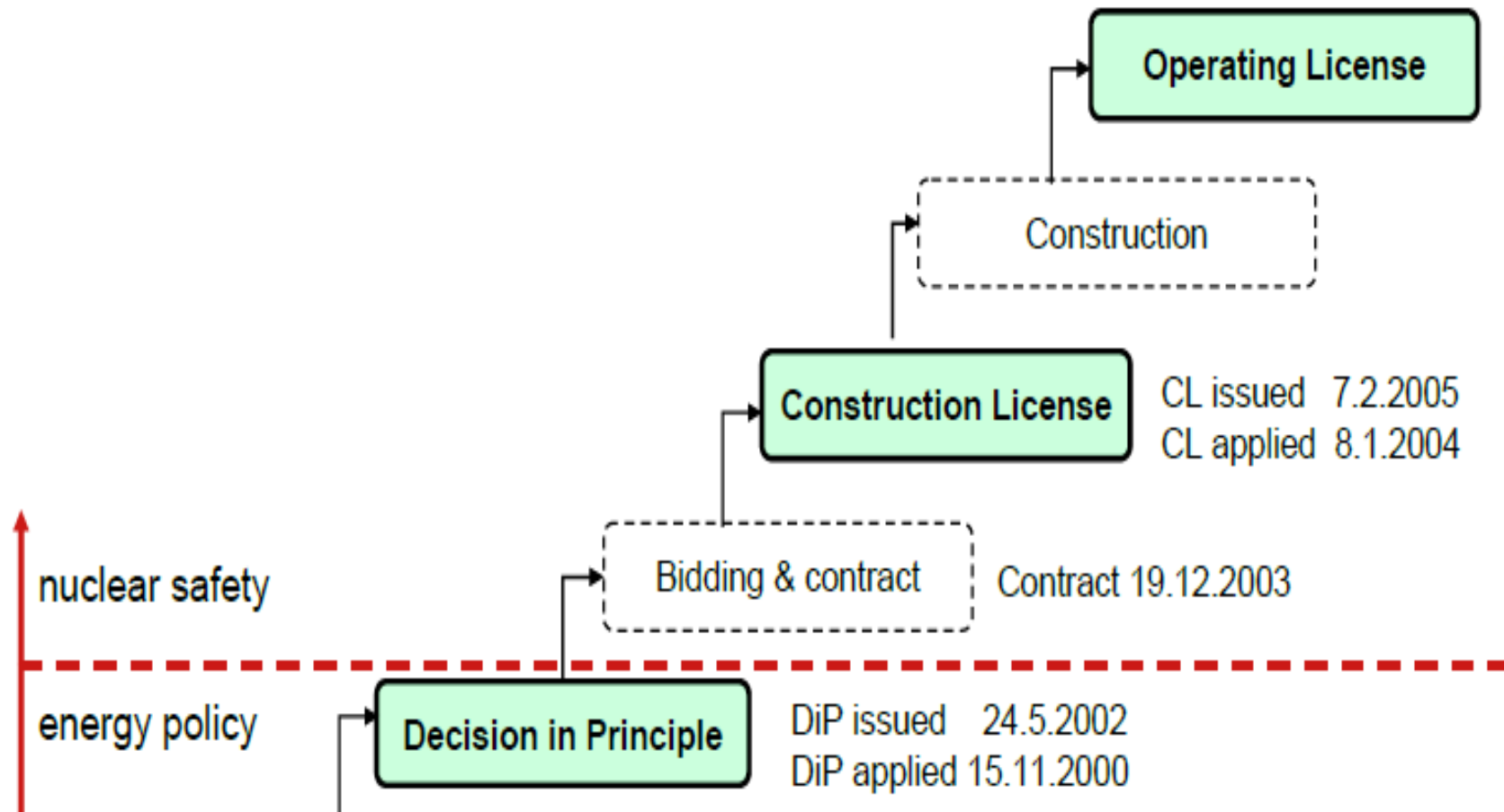


FINLAND – Nuclear Regulations

- STUK follows USNRC NUREGs conservatively
- About 70 YVL Guides „battle-tested“ at OL-3
- STUK re-wrote all Guides by 2014 (70 → 35 Guides)
- Focus on Risk-Informed (RI) Regulations
- Focus on RI system design (using advanced PRA tools)
- Verifies system performance by testing in high-fidelity full-scale plant simulator model before design approval
- Moving towards implementing ASME-III in Finland for all future new build projects (implicit in new YVL Guides)
- **OL-3 EPR Project over (9) years behind schedule: Main effort remaining is that the digital I&C architecture has to be changed in order to obtain an Operating License**

OL-3 STARTUP NOW in 2018

Licensing schedule of Olkiluoto 3





STUK – OL-3 Lessons Learned

Regulator needs to be well prepared for a NPP project and all its licensing phases. Nuclear Regulations must be up-to-date:

- requirements need to be managed
- licensing steps, licensing documentation and regulatory hold points need to be commonly understood by project parties, as well as project schedule and expectations to design completion
- competences and human resources for safety evaluations need to be evaluated and ensured

Technical Support Organizations (TSOs) are indispensable, and it was profitable to:

- use a limited number of experienced outside TSO organizations
- use organizations that are familiar with design of NPP, but independent from reactor vendor
- focus on new NPP design features

Co-operation with other Regulators to benchmark requirements, findings and coverage of review and inspection work



FRANCE – Nuclear Regulations

- **New comprehensive legal framework for licensing – 12-2005 Act on Transparency and Safety in the Nuclear Field**
- **Licensing requirements emerged over time between Regulator and EdF**
- **There is still no complete published set of Regulatory Guides / NUREGs from ASN (created in 2006)**
- **New French Reg Guides also need more testing at first EPR in France (like YVL Guides in Finland, which have been re-written)**
- **2007 RCC-M Edition is integrating French-German consensus and new regulatory provisions (12-2005 Ministerial Order)**
- **RCCM Code linked to European & French regulatory practices for PWRs (based on ASME-III but w/o 3rd Party Inspections)**

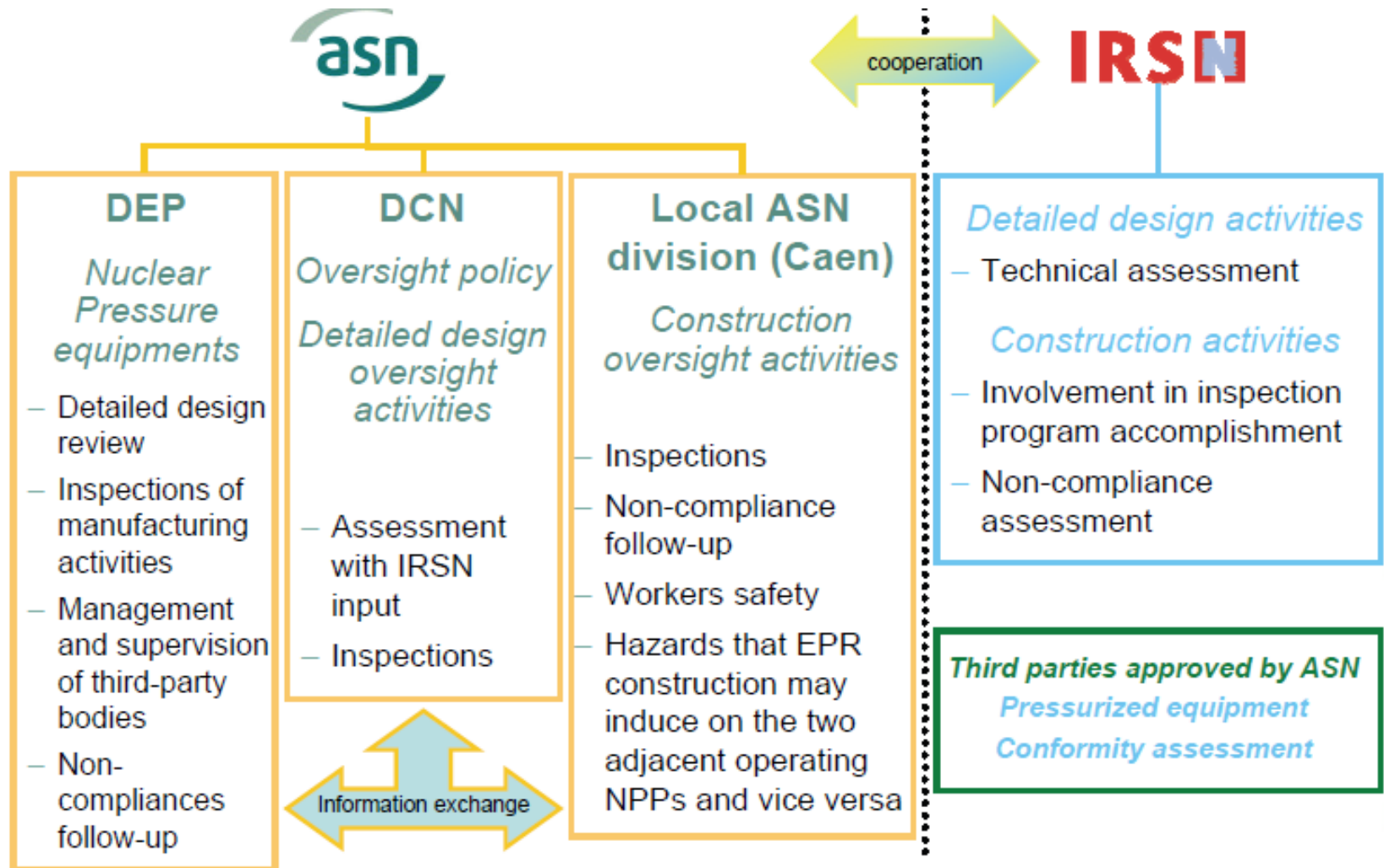


FRANCE – Nuclear Regulations (2)

- **Flamanville-3 startup now expected 2017? (5+ years delay)**
- **Major reasons for delay:**
 - **Many Lessons learned in Finland (OL-3) have not been applied at FL-3**
 - **Most important issue is EPR Digital I&C system architecture (safety signals intermingled with normal signals), which is not accepted by Authority ASN**
 - **STUK, ASN, HSE have warned about I&C issue since 2008**
 - **New ASN regulations are written while performing oversight**
 - **Design was not complete at construction start**
 - **QA deficiency and not enough oversight in supply chain**
 - **Serious quality defect discovered in Reactor Pressure Vessel (2015) – Flamanville-3 and possibly Taishan-1/2**

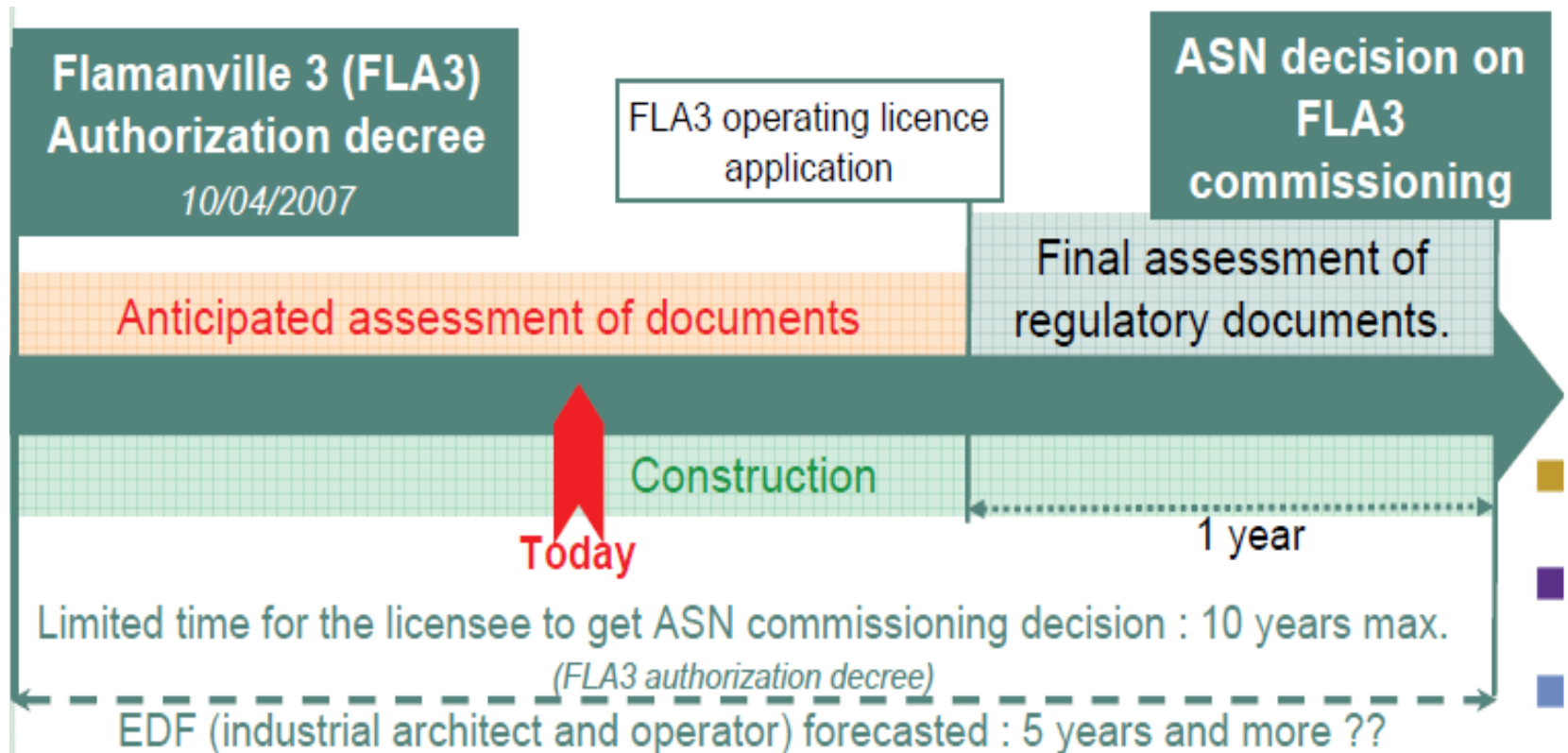
FRANCE – LICENSING OVERSIGHT

(Source: Workshop Sep 3, 2010 – Lessons Learned from Flamanville-3 Construction Oversight)



FRANCE – LICENSING PROCESS

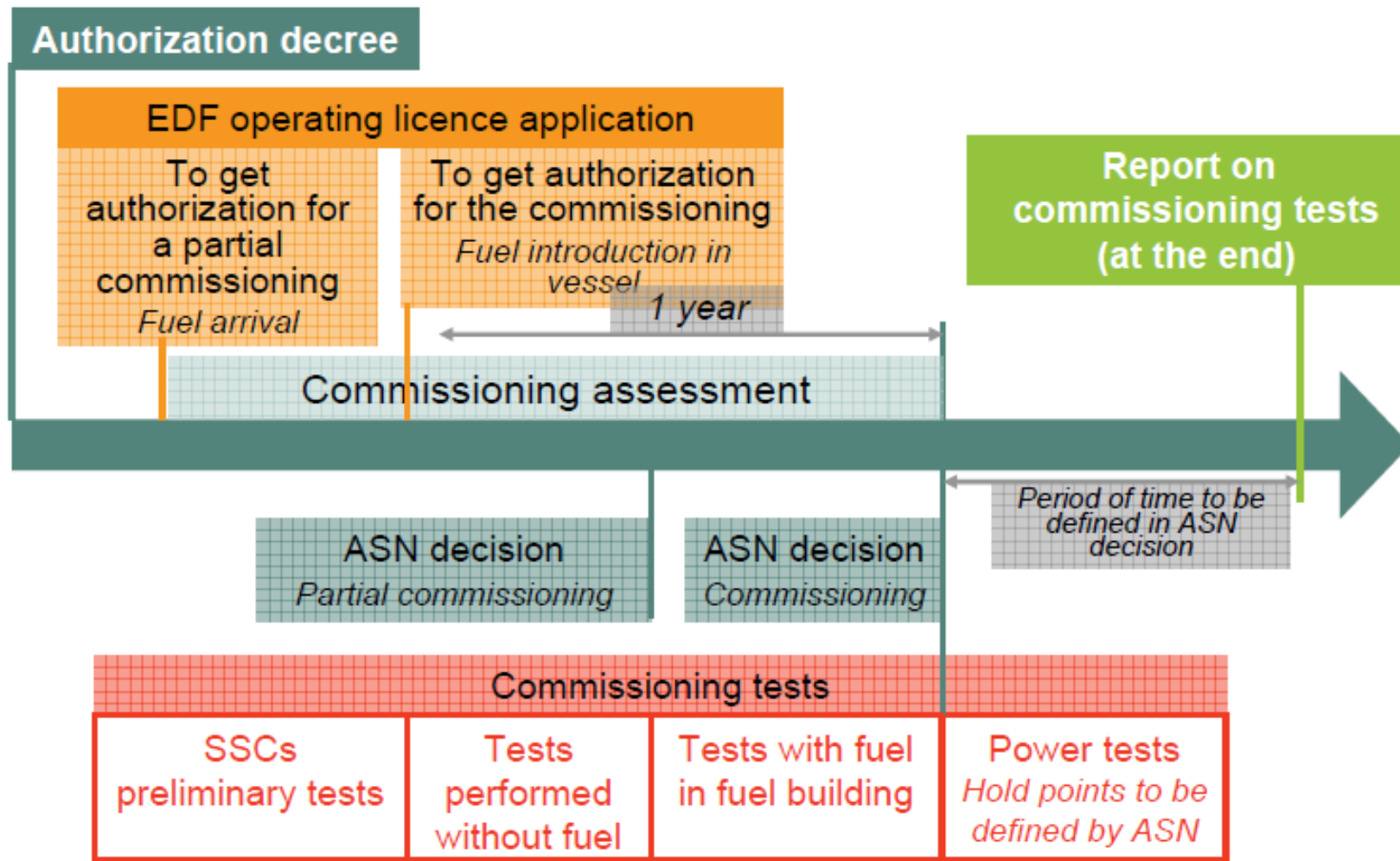
(Source: Workshop Sep 3, 2010 – Lessons Learned from Flamanville-3 Construction Oversight)



Due to the (5+) years delay in FL-3 project, the 10-year limit will become an issue.

FRANCE – COMMISSIONING PROCESS

(Source: Workshop Sep 3, 2010 – Lessons Learned from Flamanville-3 Construction Oversight)





ASN – LESSONS LEARNED

(Source: Workshop Sep 3, 2010 – Lessons Learned from Flamanville-3 Construction Oversight)

Main non compliances

- Hazards that construction may induce on the 2 adjacent operating reactors
- Hold point imposed by ASN in May 2008
- Construction joint issue
- Liner welding
- Prestressing duct
- Radiological protection events
- Manufacturing of main components ASN experience feedback
- Main causes of non compliances assessed by ASN
- ASN tools to have EDF better manage non compliances



UAE – Nuclear Regulations

- UAE developed an Atomic Law with the help of outside Experts and IAEA Guidance. Based on this Federal Law the Federal Authority for Nuclear Regulation (FANR) was established 9/2009 as an independent Regulator.
- FANR with Expat help has developed their Nuclear Regulations based on IAEA Safety Series Guides and applicable USNRC Regulations.
- FANR currently has over 200 staff from 25 countries, of which 54% are Emiratis. An extensive Training Program is in place to further develop a skilled cadre of Emiratis.
- UAE is the first “newcomer” country since 1981 (China) to issue a Construction License for a NPP.

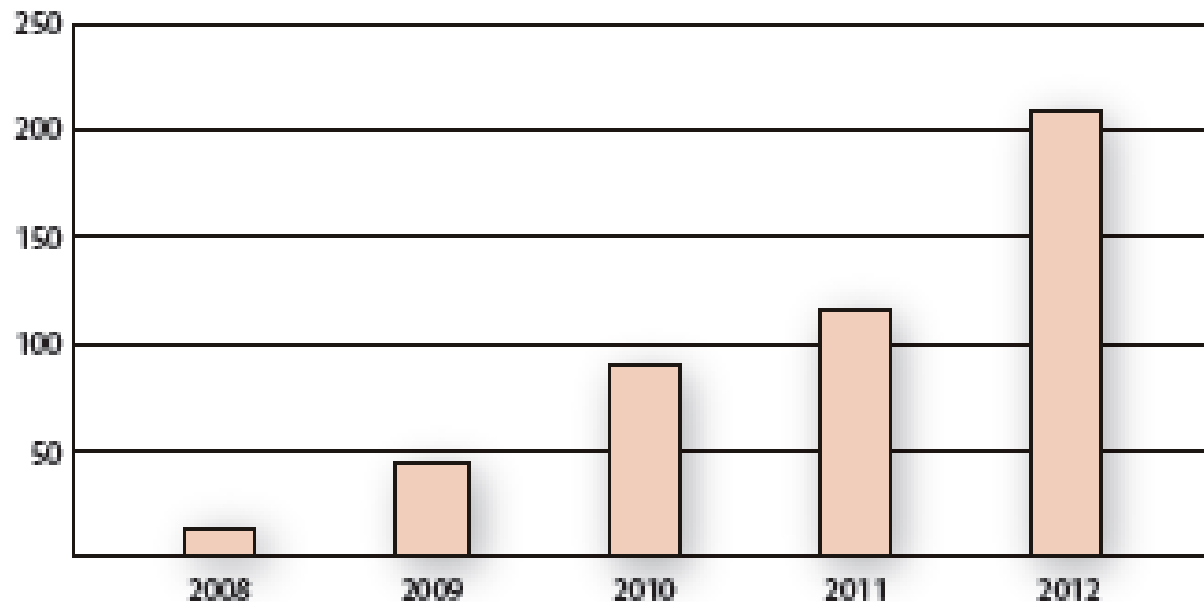
UAE – Nuclear Regulations (2)

- A 9,000-pages Construction License Application (CLA) for Barakah-1/2 was submitted by ENEC in 12/2010 and approved by FANR on July 17, 2012.
- In March 2013 ENEC submitted a CLA (10,000 pages) for Barakah-3/4, and FANR issued the CL in 9/2014.
- In March 2015 ENEC submitted the Operating License Application for Barakah-1/2 (15,000 pages).
- The PSAR included in the CLA consists of over 9,000 pages, and the FANR SER (approval basis) is more than 2,500 pages.
- Total FANR CLA review and approval required over 150 man-years of effort over a period of 18 months and with 60 FANR staff and more than 200 Experts involved (incl. support from IAEA and from 7 TSOs).

UAE – Nuclear Regulations (3)

(Source: FANR Annual report 2011)

Past, Current & Planned Staffing Levels



FANR plans to have more than 200 staff members by the end of 2012. FANR's Human Resources Department is working to strengthen FANR with experts who can set up functions and facilitate operations, and with Emiratis who have the talent to contribute now and lead in the future.



UAE – Nuclear Regulations (4)

(Regulations Set Developed with Outside Assistance)

FANR Regulations
FANR REG-01, Management Systems
FANR REG-02, Siting of Nuclear Facilities
FANR REG-03, Design of Nuclear Power Plants
FANR REG-04, Radiation Dose Limits & Optimisation of Radiation Protection for Nuclear Facilities
FANR REG-05, Probabilistic Risk Assessment
FANR REG-06, Application for a Licence to Construct a Nuclear Facility
FANR REG-07, Nuclear Facility Construction
FANR REG-08, Security – Physical Protection including Access Controls
FANR REG-09, Import / Export Controls
FANR REG-10, Safeguards and Material Control and Accounting
FANR REG-11, Radiation Protection and Radioactive Waste Management for Nuclear Facilities
FANR REG-12, Emergency Preparedness at a Nuclear Facility
FANR REG-13, Transportation of Radioactive Materials
FANR REG-14, Application for a Licence to Operate a Nuclear Facility
FANR REG-15, Design Modifications during Operation
FANR REG-16, Operational Safety including Testing, Surveillance and Reporting
FANR REG-17, Certification of Operations Personnel
FANR REG-18, Administrative Liabilities and Penalties
FANR REG-19, Criminal Penalties
FANR REG-20, Application for Operating Licence Extension of a Nuclear Facility
FANR REG-21, Decommissioning
FANR REG-22, Decommissioning Trust Fund
FANR REG-23, Security of Radioactive Sources
FANR REG-24, Basic Safety Standards for the Conduct of Regulated Activities with Regulated Material.



UK – Nuclear Regulations

- Nuclear Installations Act 1965 unchanged
- UK Regulatory Authorities pursue two unique requirements:
 - ALARP (As Low As Reasonable Practical), i.e., each significant design decision has to be evaluated and documented to show that ALARP was applied as well as BAT (Best Available Technology)
 - If this cannot be shown it represents breaking the law/regulation
- ONR Inspectors decide approvals – making the licensing process somewhat uncertain until to the very end
- GDA process helps streamlining the licensing process, but does not change the basic requirements (cost ~\$40 Million)
- ESBWR and ACR1000 withdrew from GDA process early on
- Areva stopped ~1 year short of completion with an „Interim Approval“ issued, and Westinghouse stopped ~2 years before completion waiting on a Customer



UK – Nuclear Regulations (2)

- The ONR and EA jointly issued Interim Design Acceptance Confirmations (iDACs), and Interim Statements on Design Acceptability (iSODA) for EPR and AP1000 in December 2011.
- Westinghouse had requested a pause in the GDA process pending customer interest. As Toshiba / Westinghouse became 60% part of NuGen, the GDA the process for AP1000 has resumed, and is scheduled to be completed in January 2017 with issuance of final DAC and SODA.
- Serious licensing issues arose with EPR in Finland and France (see joint regulatory statement on the EPR digital I&C design among ONR, US NRC, France's ASN and Finland's STUK), slowing the EPR final DAC and SODA issuance.



UK – Nuclear Regulations (3)

- Early in 2013 Hitachi-GE applied for GDA for its ABWR, and in August 2014 the ONR and EA completed the second GDA stage of this, and cleared it to proceed to stage 3. The whole GDA process should be completed by the end of 2017.
- In 2015, China General Nuclear Power Group (CGN) said it intended to apply in 2016 for GDA for the 1150 MWe Hualong-1 reactor design (“merging “ AP1000 and CPR1000), with a view to building it at the Bradwell Site.
- Rosatom (together with Rolls-Royce and Finnish FORTUM) announced plans to submit their VVER-1200 TOI design to the UK GDA process in 2015. An Intergovernmental Agreement (IGA) to support this Project was signed in September 2013. Due to political reasons (Ukraine) - this has not progressed.

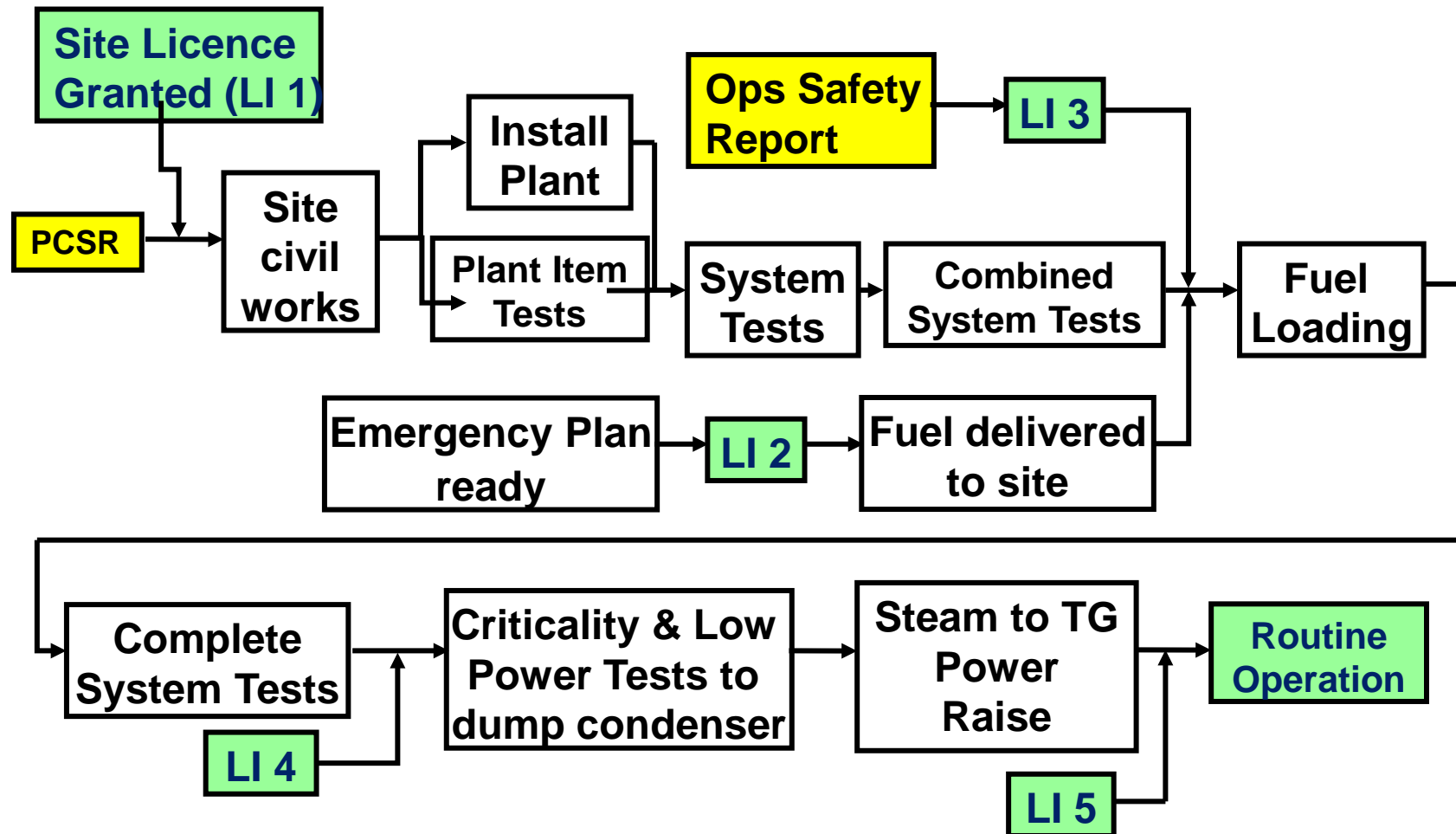


UK – ONR Plan for 2015/16

- **Complete Step 3 of the GDA of the UK ABWR Reactor design and commence Step 4**
- **Assess the proposed resolution of outstanding Issues for the AP1000 reactor design intended to lead to the issue of a Design Acceptance Confirmation (DAC), associated with the development of the Moorside Site in Cumbria**
- **Provide advice and challenge to potential Licensees developing “right first time” nuclear site license applications in relation to Wylfa Newydd in Anglesey, Moorside, near Sellafield in Cumbria, and Sizewell C in Suffolk**
- **Deliver an inspection, assessment and permissioning regime which will provide efficient and effective nuclear regulations as necessary during the building of a new NPP at Hinkley Point C in Somerset, subject to EdF making a final investment decision.**

UK – LICENSING PROCESS

(Hold Points LI 1 to LI 5)





USA – Nuclear Regulations

- One-step (COL) Part 52 to streamline licensing process
- First COL issued to LES Enrichment plant
- Early Site Permit (ESP) bankable up to 20 years
- Design Certification Document (DCD) for all new Gen-III/III+ designs – valid for 15 years
- NRC is in process of modifying existing Reg Guides to become Risk-Informed Reg Guides, which is long term goal
- Large parts of ASME Code are introduced into US laws
- ASME strongly linked to US licensing practices
- 10CFR50 App B / NQA-1 for QA
- All new build NPP designs in U.S. have standardized Improved Technical Specifications (ITS)



USA – Nuclear Regulations (2)

- For period 2007-16 USNRC had originally Licensing Applications for (37) new build reactor units
- There are now (3) NPP Projects, which have received either a R-COL and a S-COL, now under construction:
 - **First R-COL for Southern Company Vogtle-3 & 4 (AP1000)**
 - **First S-COL for SCANA VC Summers-3 & 4 (AP1000)**
 - **Third COL for DTE Energy FERMI-3 (ESBWR) issued 5/1/15 (not under construction)**
- **ABWR, AP1000 and ESBWR already have Design Certifications**
- **APR1400 DCD submitted 12/2014 and under review**
- **EPR and APWR1700 DCDs are on hold or delayed**



USA – Nuclear Regulations (3)

Currently Active Generic issues

GI No	Currently Active Generic Safety Issues (Status 4Q2014)	Planned Closure	Months Open
191	Assessment of debris Accumulation on PWR Sump Performance	12/2018	219
193	BWR ECCS Suction Concerns	Tbd	151
199	Implication of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern USA for Existing Plants	Tbd	115
204	Flooding of NPP Sites Following Upstream Dam Failures	TBD	35



USA – Nuclear Regulations (4)

Most Recent New Regulatory Issues

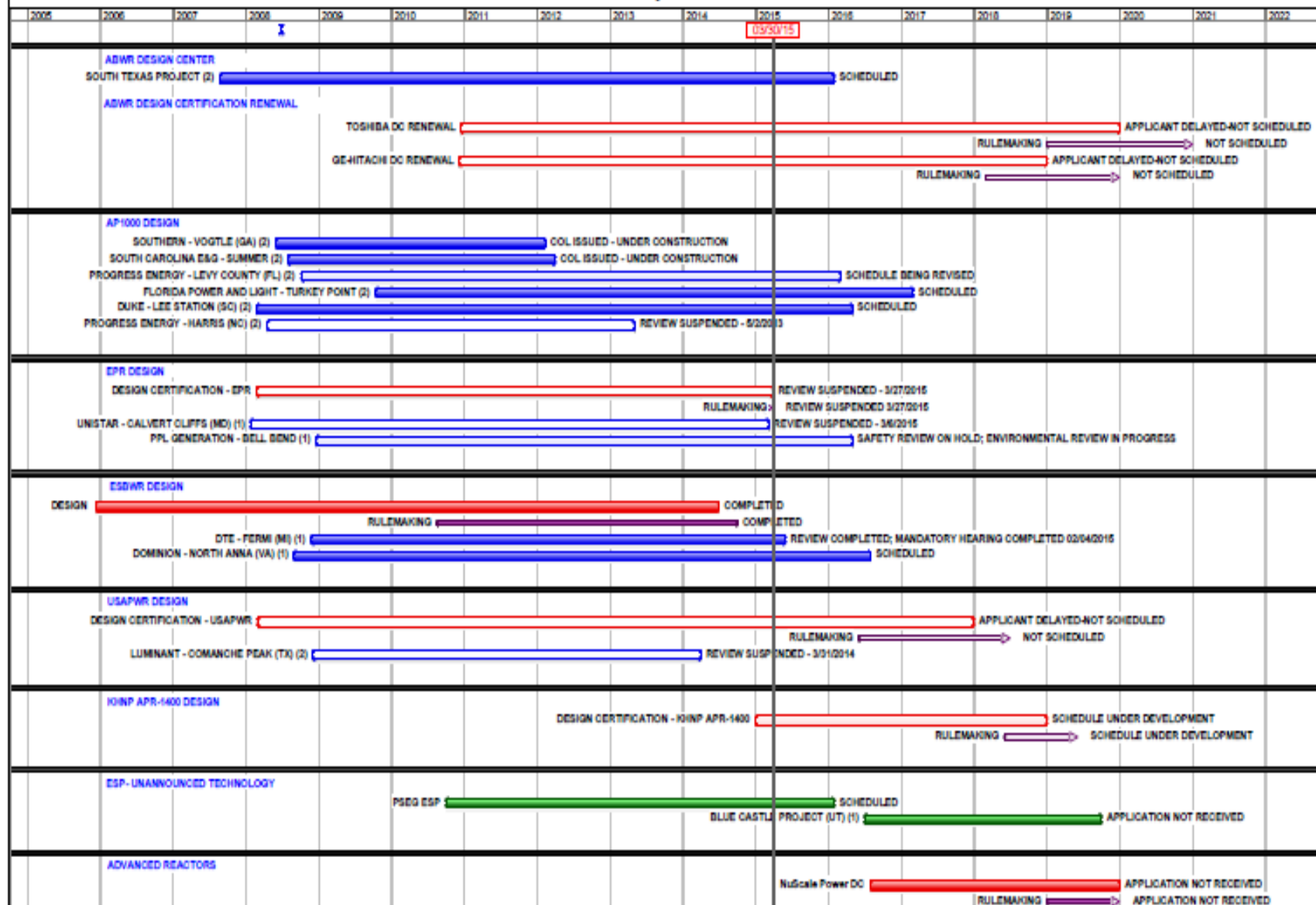
Document	Most Recent New Regulatory Issues (2015)
<u>RIS 15-07</u>	Process for Scheduling and Allocating Resources in FY 2017 for the Review of New Licensing Applications for Large Light-Water Reactors and Small Modular Reactors
<u>RIS-15-06</u>	Tornado Missile Protection
<u>RIS 15-05</u>	Preparation and Scheduling of Operator Licensing Examinations
<u>RIS 15-04</u>	Withdrawal of Administrative Letter 93-01
<u>RIS 15-03</u>	Identifying and Reporting Security Incidents Under 10CFR Part 37
<u>RIS 15-02</u>	Reporting of H-3, C-14, Tc-99, and I-129 on the Uniform Waste Manifest
<u>RIS 15-01</u>	Qualification Requirements for Bolt and Stud Non-Destructive Examinations

USA – New Build Status

Site	Technology	Utility	Construction start	COD
Watts Bar 2	Westinghouse PWR	Tennessee Valley Authority	2007 re-start	Oct 2015
Vogtle 3	AP1000	Southern Nuclear Operating Company	March 2013	Q2 2019
Vogtle 4	AP1000	Southern Nuclear Operating Company	Nov 2013	Q2 2020
V.C.Summer 2	AP1000	South Carolina Electric & Gas	March 2013	mid-2019
V. C. Summer 3	AP1000	South Carolina Electric & Gas	Nov 2013	mid-2020

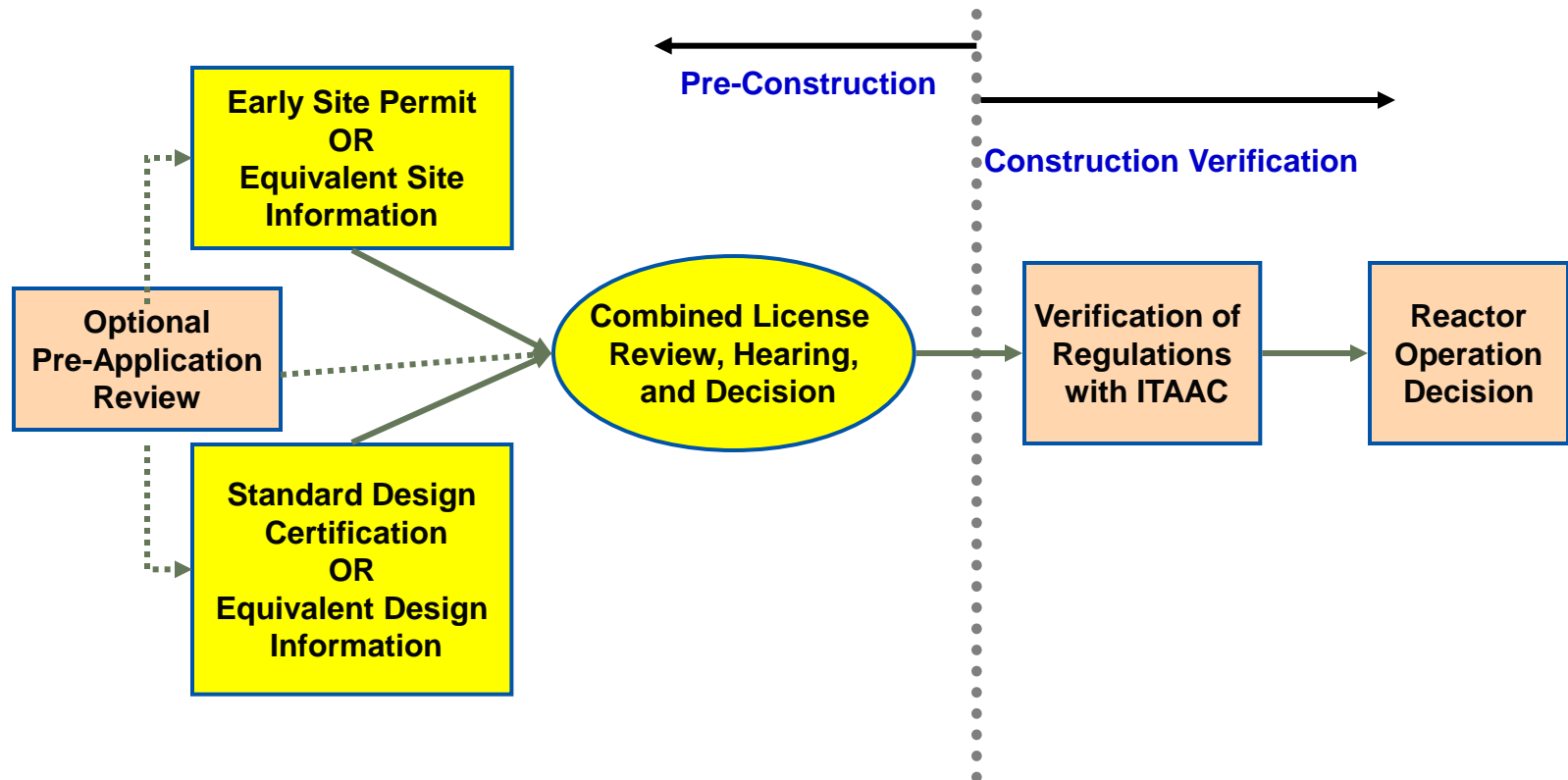
USA – Nuclear Licensing Status

New Reactor Licensing Applications
Schedules By Calendar Year



U.S. – NEW LICENSING PROCESS

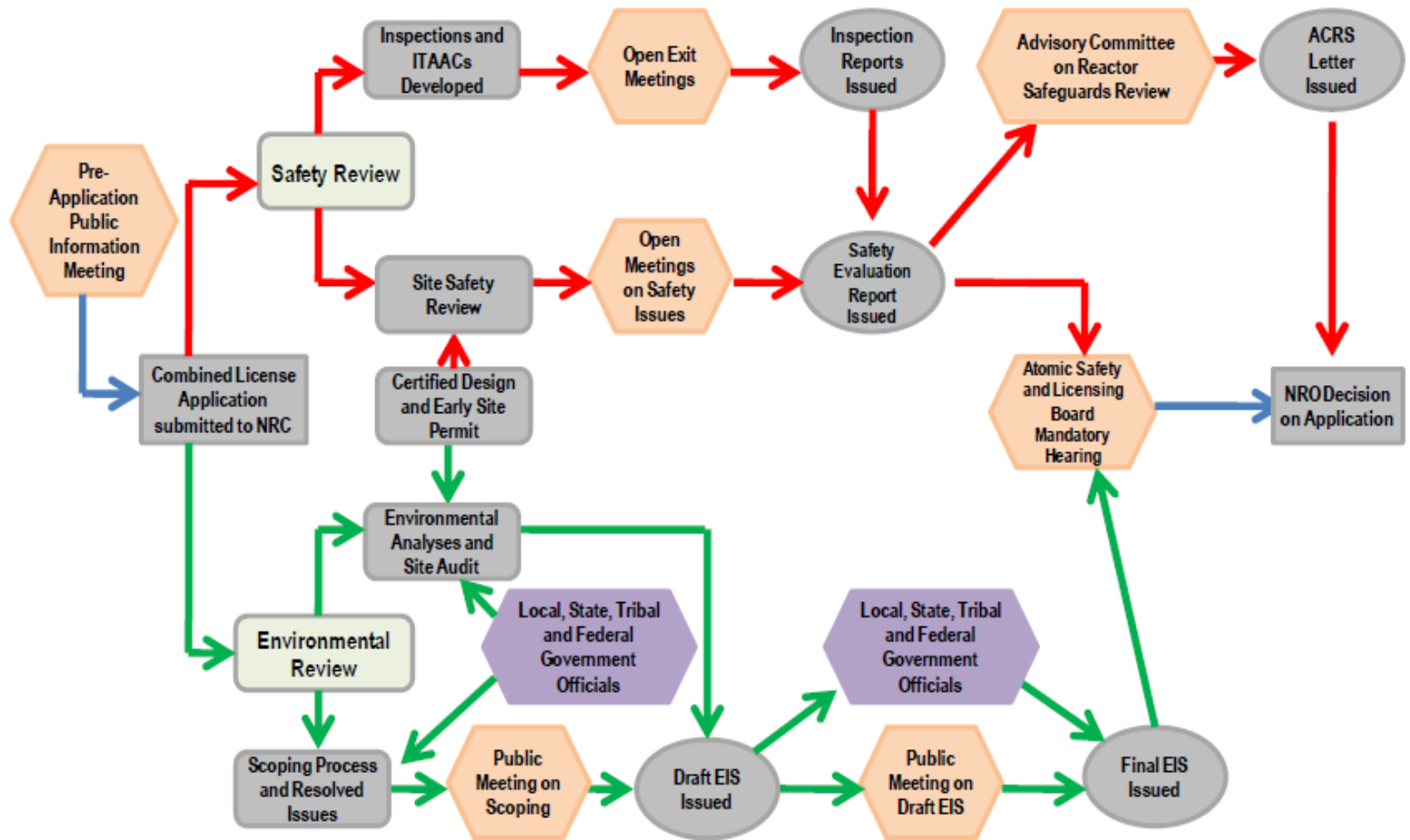
Part 52 (1-step)



- Licensing decisions finalized before major construction begins
- Inspections with ITAAC to verify construction
- Limited work may be authorized before COL issuance

U.S. – NEW LICENSING PROCESS

Part 52 (1-step)





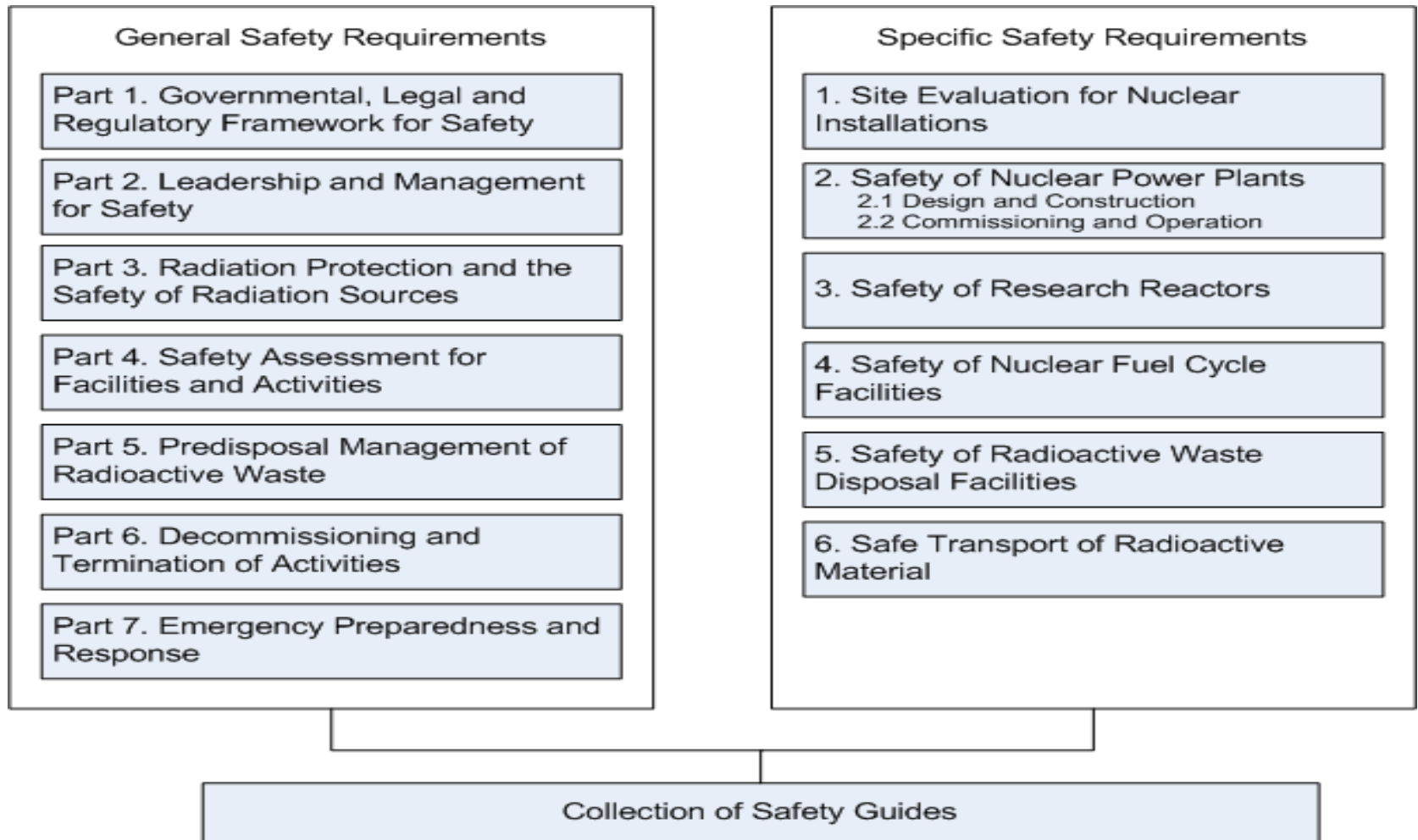
USNRC Design Control Document (valid 15 years)

1. General Description of the Plant	11. Radioactive Waste Management
2. Site Characteristics	12. Radiation Protection
3. Design of Structures, Systems & Components	13. Conduct of Operations
4. Reactor	14. Initial Test Program
5. Reactor Coolant Systems	15. Safety Analyses
6. Engineered Safety Features	16. Technical Specifications
7. Instrumentation & Controls	17. Quality Assurance
8. Electrical Power	18. Human Factors Engineering
9. Auxiliary Systems	19. Probabilistic Risk Assessment
10. Power Conversion Systems	20. Severe Accidents

IAEA - Nuclear Recommendations

- IAEA has developed a hierarchical set of recommendations and safety guides that establish a basis for an adequate level of safety for the people and the environment.
- The standards reflect an international consensus on what constitutes a high enough level of safety.
- ASME and NQA-1 are acceptable under IAEA
- ISO2001 is not sufficient under IAEA for new NPP QA
- The following slide shows the structure of the IAEA requirements and safety standards.

IAEA Nuclear Safety Guide Structure



JAPAN - Nuclear Regulations

- METI Ordinance No. 62 (2006) General Technical Standards
- Detailed Technical Codes & Standards applied by NISA:
 - JSME (Japan Society of Mechanical Engineers)
 - AESJ (Atomic energy Society of Japan)
 - JEA (Japan Electrical Association)
- JSME Code equivalent to METI Notification 501 (based on ASME-III), some improved/additional provisions to reflect up-to-date technologies
- No accreditation of manufacturers and fabricators
- Independent 3rd party inspection replaced by Gov inspection
- Japan plans to harmonize JSME code for international use
- **New Regulator (NRA, as of July 1, 2013)**
- **NRA is rewriting all major Regulations post Fukushima**

JAPAN - Nuclear Regulations (2)

- JEA established JEAC (Technical Codes) and JEAG (Technical Guidelines)
- 2003: JEAC4111 QA code for NPP was established (based on ISO9001-2000 and IAEA 50-C/SG-Q (1996))
- 2005: JEAG4121 QA Guideline was established for NPP (Guideline of JEAC 4111)
- 2007: Implementation of the newly developed IAEA safety standard GS-R-3 “Management System” is planned
- **New post-Fukushima Regulations to be developed by new Regulator (NRA) established as of July 1, 2013**

JAPAN - Nuclear Regulations (3)

Before March 11, 2011

- No regulatory requirements for Severe Accident Management (SAM)
- No adequate requirements for Seismic or Tsunami protection
- SAM procedures prepared voluntarily by each Utility company
- No realistic Emergency Planning and preparedness (no ERG procedures)
- Prolonged SBO was not anticipated (therefore no equipment on site)
- Filtered vent system was not prepared
- SAM in multi units simultaneously was not anticipated
- Drills for emergency situations were completely inadequate/absent
- Evacuation plan for 100,000+ population did not exist at all

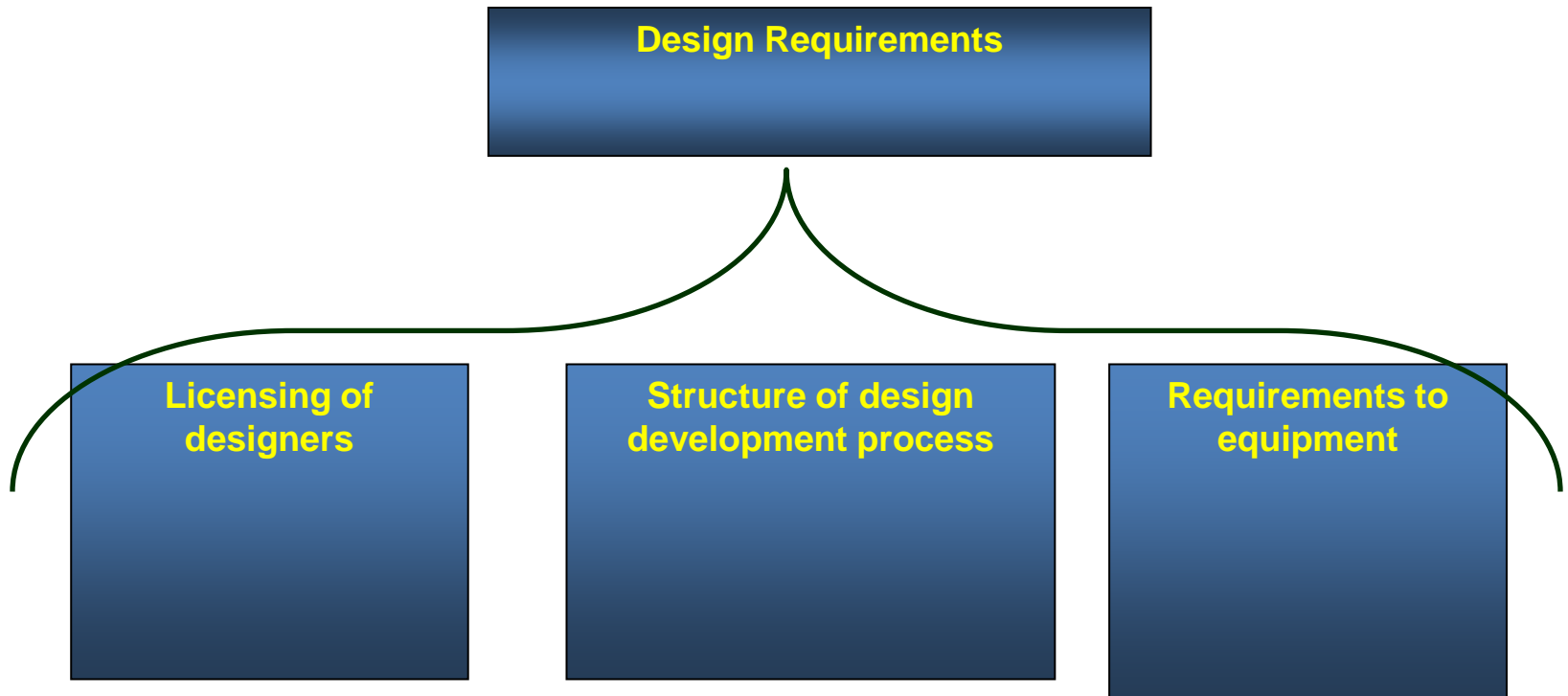
After March 11, 2011

- Regulatory requirements to cope with SAM will be developed
- Emergency preparedness will be reviewed and enforced
- New Regulatory Agency (NRA) like a US NRC – effective July 1, 2013
- No restart w/o Tsunami protection walls at certain Sites (15 meters)

RUSSIA – Nuclear Regulations

- **OPB-88/97 contains requirements of providing NPP safety by sequential implementation of defend in depth concept (DDC) including 5 levels into the design**
- **Comparison with IAEA: A 1994 "Comparison of the Russian NPP Safety Concept Contained in OPB-88 and the Next Lower Level Norms/Rules with the IAEA NUSS Requirements" has confirmed that Russian basic principles, standards and requirements in the field of safety are, in their essence, similar to the international standards developed in the frame of IAEA Nuclear Safety Standards Program**
- **Federal Law 170, Article 37: The equipment, components and production processes for nuclear installations... are subject to compulsory certification**
- **Licensing Guidelines...." Decree №865 " dated June 14, 1997**

RUSSIA - Nuclear Regulations (2)



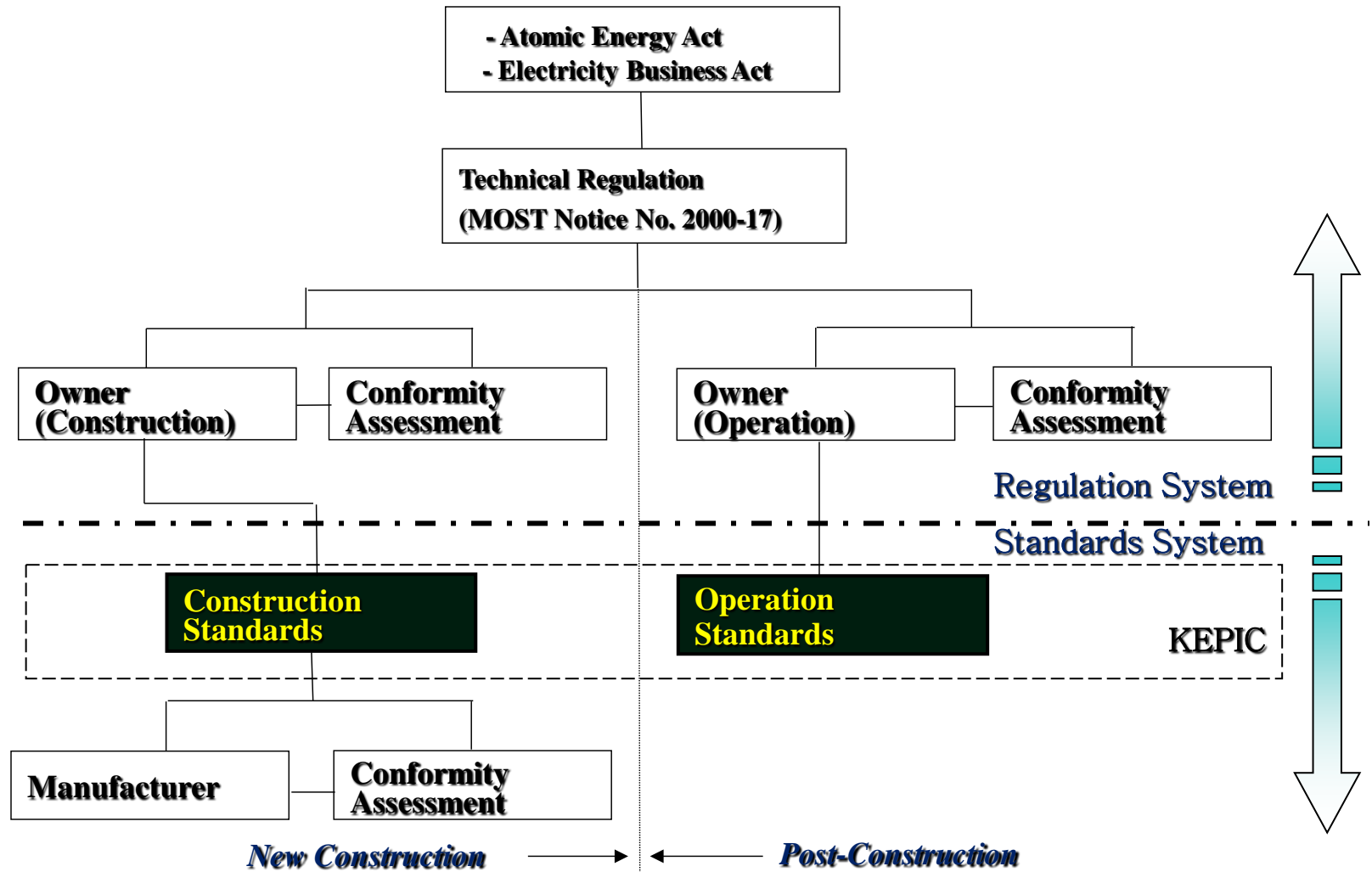
RUSSIA - Nuclear Regulations (3)

License	Safety Analysis Documents (RD-04-27-2006)
NPP Siting	<ul style="list-style-type: none">- PSAR (descriptions of selected site and description of all safety-related aspects, conceptual description of NPP, and its environmental safety and safety of the population, including PSAR)
Unit construction	<ul style="list-style-type: none">- Preliminary SAR of a NPP- Design documents (Reactor design, safety-related systems, ... Test and R&D reports)- Level 1 PSA
Unit operation	<ul style="list-style-type: none">- FSAR, to be submitted before COD- Process Manual for Reactor operation- Level 1 PSA- Operating Procedures

SOUTH KOREA - Nuclear Regulations

- **Adapted ASME – with editorial changes and some exceptions to produce a ‘localized’ Korean version of ASME accreditation maintained by KEA (Korean Electric Association):**
 - **Korean Accreditation System for Vendors**
 - **Korean Registered Professional Engineers**
 - **Korean Authorized Independent Inspection**
- **IAEA QA & NQA-1 used in Korea, ISO9000 for non-nuclear**
- **Accepts nuclear Regs & Codes from country of origin**
- **Plans to switch to ASME based Code for off-shore business**
- **Relies on IAEA and USNRC Regs for off-shore projects**

SOUTH KOREA - Nuclear Regulations (2)



SWEDEN - Nuclear Regulations

- Plans to replace some of its 10 aging NPPs starting in ~2030
- Plans to shut down 4 oldest operating NPPs by 2020
- Swedish Regulations are very high-level:
 - Oversight of application of acceptable Reg Guides
 - Utilities can in principle decide to use any major nuclear country's Reg Guides (e.g., USA, French, German, Japanese, Korean, etc – but they must use one single consistent set of Reg Guides)
 - Regulator (SSM) will check that the Utility understands and uses that selected set of Regulations consistently
 - Swedish utilities use US NRC Reg Guides as a basis for licensing
- Swedish Regulators are not „believing in“ Risk-Informed regulations
- Swedish Regulations are the most compact – a few SKIFS documents only (because of the high-level nature of regulation)
- Post Fukushima all Swedish NPP's need to install a completely new and independent core cooling system latest 2020

SWITZERLAND - Nuclear Regulations

- In 2009, ENSI (Swiss Nuclear Safety Inspectorate) was established as an independent Agency (replacing HSK)
- Switzerland planned originally to replace its 5 oldest NPPs (Beznau-1/2, Muehleberg and Goesgen) starting in ~2013) - now on hold indefinitely because of Fukushima
- Nuclear Referendum in ~ 2020 could overturn current holdup
- Two applications for a Framework Approval filed in 2008
- Swiss used the U.S. Regulations as a basis with added local requirements (more stringent)
- The oldest Swiss plants were upgraded with improved (bunkered) Emergency Core Cooling systems 30 years ago
- Swiss accept nuclear Codes from country of origin
- **Swiss ENSI was first with very precise/stringent Fukushima evaluations to allow continued operation of all Swiss NPPs**



Nuclear Regulations – International Developments

IAEA SUPPORT OF INTERNATIONAL DEVELOPMENTS IN NUCLEAR REGULATIONS



IAEA SUPPORT TO REGULATORS

Important Initial Activities

- There is a need for a National policy for nuclear capacity planning, decommissioning and waste management strategies
- The nuclear policy document should also consider the level of planned national participation by industry and the impact of the required human resources over the lifetime of the program
- The decision to develop nuclear energy means at least ~100 year commitment for the country based on the development period, the operation of the NPPs, and decommissioning, as well as managing and storing used fuel



IAEA SUPPORT TO REGULATORS

Important Initial Activities (2)

- IAEA Guides / Requirements Documents do not provide a complete Regulatory Structure, since they are a set of Guide Lines only. National Regulatory infrastructure is in addition to the IAEA Guides.
- New NPP Countries and/or new NPP Projects need to closely follow, and meet/exceed IAEA Guidance – or risk strong resistance from involved stakeholders (e.g., Strategic Investors, etc), and the international nuclear community.
- IAEA cannot act as a Consultant and actually do the Regulatory infra-structure implementation work in a new country for a new NPP project.



IAEA SUPPORT TO REGULATORS

Important Initial Activities (3)

- TMI accident proved the need to have an independent Regulator to restore & maintain Public Confidence.
- A newcomer country is well advised to establish an independent Regulator initially, but no later than at Construction start, in order to maintain Public confidence and reduce concerns in the international community.
- Fukushima could have been avoided if the Japanese Regulator had been completely independent (Japanese Parliamentary Inquiry July 2012 Conclusion).
- When deciding on the appropriate Regulatory Infrastructure the “culture” of the country is an important consideration (“one size/model does not fit all”).



IAEA SUPPORT TO REGULATORS

Important Initial Activities (4)

- This will be helpful in selecting which major nuclear country has the regulatory infra-structure that could be the best starting point for an emerging nuclear country.
- It is very important to stick to one consistent regulatory infra-structure model, and “cherry-picking best practices” from several countries is not a good solution at all.
- International trend towards “Harmonization” of regulatory practices worldwide should also be considered upfront.
- The new country Regulator must become completely independent once construction starts on first NPP, or the local Public and international community plus important stakeholders will lose confidence quickly, absent any independent NPP project oversight.



IAEA SUPPORT TO REGULATORS

Important Initial Activities (5)

- Should Environmental Licensing / Permitting belong to Nuclear Regulator or not? If not – what will be the interface procedures with Environmental Authority?
- Using the Regulations of the home country of the NPP supplier is a safe starting point covering most issues.
- IAEA SSG-16 (National Nuclear Infrastructure) and IAEA SSG-12 (Licensing of Nuclear Facilities and NPPs) are the most important Guides at start of NPP Program.
- New Regulator should be guided by principles of:
 - Risk-informed decision making
 - Graded approaches to Licensing and QA
 - Standardized designs and approvals
 - Support Harmonization of regulations worldwide



Nuclear Regulations – International Developments

CHARACTERISTICS OF A CREDIBLE NUCLEAR REGULATOR



CHARACTERISTICS OF A CREDIBLE NUCLEAR REGULATOR

- Based on a National Nuclear Policy that outlines the basis for an independent, vigilant and effective Regulatory Authority, which is the cornerstone of any stable, credible, safe and secure nuclear energy program. Characteristics of a Credible Nuclear Regulator include:
 - complete operational transparency
 - highest standards of non-proliferation
 - highest standards of safety and security
 - direct connection with the IAEA and conformance to its standards in evaluating and potentially establishing a peaceful nuclear energy program
 - partnerships with the governments and companies of responsible nations, as well assistance from relevant expert organizations
 - an approach to the peaceful domestic nuclear power program that best ensures long-term sustainability



CHARACTERISTICS OF A CREDIBLE NUCLEAR REGULATOR (2)

- The new nuclear build country must implement all obligations under the relevant international treaties, conventions or agreements and the Regulator must adhere to them.
- The Nuclear Regulator has the authority to determine all matters relating to the control and supervision of the nuclear sector in the country, in particular those relating to nuclear safety, nuclear security, radiation protection and safeguards.
- The Nuclear Regulator is responsible for issuing regulations and licenses to conduct regulated activities; carrying out safety assessments; and implementing an inspection and control regime.



CHARACTERISTICS OF A CREDIBLE NUCLEAR REGULATOR (3)

- The Nuclear Regulator must set up and operate the system of accounting and control of nuclear material and must establish frameworks for the physical protection and emergency preparedness and response for nuclear facilities and activities.
- The Nuclear Regulations development process shall allow the public to make comments on the draft regulations, including site location, nuclear power plant administrative systems, emergency preparedness, transport of radioactive materials, reactor licensing systems, and nuclear facility design, in keeping with the commitment to transparency.



CHARACTERISTICS OF A CREDIBLE NUCLEAR REGULATOR (4)

- The culture of a Nuclear Regulator is fundamental to its success and future strength and must be established at the beginning of its infrastructure development in line with the national Nuclear Policy.
- The Nuclear Regulator must undertake a thorough review of technical submissions for a license for a NPP in order to assure itself that the available information demonstrates the safety of the NPP; that the information is accurate and sufficient to confirm compliance with regulatory requirements; and that technical solutions proposed can be demonstrated to achieve the required level of safety.



CHARACTERISTICS OF A CREDIBLE NUCLEAR REGULATOR (5)

- The Nuclear Regulator cannot delegate its responsibility for review and assessment to another regulatory body.
- However, if a NPP has already undergone reviews by one or more Regulatory Body in other countries, it is acceptable to use that work when carrying out its independent review and assessment as required by the Nuclear Law.
- The site selection approval process shall ensure that the selected site will have characteristics that will provide for a high level of protection for public health and safety and the environment throughout the life of the nuclear installation.



Nuclear Regulations – International Developments

**EXCEL SUPPORT OF INTERNATIONAL
DEVELOPMENTS IN NUCLEAR REGULATIONS
FOCUSED ON REGULATORS**



EXCEL Support and Solutions

Support to - Regulators

- **EXCEL** can provide all Licensing and Permitting support needed for a new build projects in new countries:
 - Developing Atomic Law
 - Developing Nuclear Regulations required
 - Set up Nuclear Regulator and training/mentoring
 - Develop regulatory programs/processes/procedures
 - Expert/TSO support to handle Safety Analyses and Construction License Application review & approval
 - Support Regulators with Construction Oversight
 - Train Regulator staff to become independent
 - Get Regulator ready (staffed/trained) for Operating License review & Commercial Operation Oversight



EXCEL Support and Solutions

Support to – Regulators (2)

- **EXCEL** can provide training and capacity building quickly and reliably to any new Regulator, because we know/have worked with:
 - all major Nuclear Regulatory organizations
 - all major Nuclear Regulations
 - new nuclear Regulators (and their buildup)
 - have supported most Gen-III/III+ Design Certifications
 - have successfully supported complete licensing efforts (Site Permit, Construction License/Operating License) for Gen-II and Gen-III/III+
 - can bring relevant lessons learned to a new Regulator
 - can help the new Regulator to coordinate all work needed for the first NPP license application, its review and approval process
 - can help the new Regulator to “manage” the TSOs required (minimum 3-4) to do all specialist work (e.g., Safety Analyses).



EXCEL Support and Solutions

Support to – Regulators (3)

EXCEL can support Regulators from the very beginning of a new Nuclear Program:

- Review and approval of Emergency Planning
- Nuclear Safeguard
- Reload fuel license approval
- Waste management oversight and approval
- Decommissioning plan approval
- Power Uprate and Life extension approval
- Safety Culture training and support
- Security (Physical, Cyber)
- Digital I&C systems



EXCEL Support and Solutions

Support to – Regulators (4)

- **EXCEL** can provide efficient licensing support, based on its unique USNRC experience / relationship:
 - **EXCEL** has unmatched credibility and reputation with USNRC
 - Daily interface with NRC over past 30 years
 - Providing continuously resolutions of generic licensing issues
 - Close working relationships with all NRC Technical Departments
 - Close proximity to NRC Offices (within a 1/4 mile)
 - **EXCEL** has an electronic data base containing all USNRC decisions and paper trail behind (saves time addressing issues already resolved) .



EXCEL Support and Solutions

Support to – Regulators (5)

Example: Setting up a robust/credible Regulator

	Steps	Requirement
1	National Nuclear Policy	International Conventions and independent Regulatory Power and Duties of Regulator
2	Set up Independent Nuclear Regulator	Independent Nuclear Regulator empowered to enact credible and transparent Nuclear Regulations, Oversight and has the Powers to ensure safety of nuclear facilities
3	Develop Nuclear Regulations	Use existing international Nuclear Regulations - customized to new Country (about 30 – 40 needed)
4	Buildup Local Regulatory Organization to required capacity	Bring in the required experts (initially mainly Expats) to be able to issue the required initial Licenses within 12 -18 months for Site / Construction License
5	Train and mentor the local Regulator	Expat experts will provide continuous training / mentoring to buildup local competence
6	Startup, Operations, Decommissioning	Expat experts will provide continuous training / mentoring to buildup required competence before needed



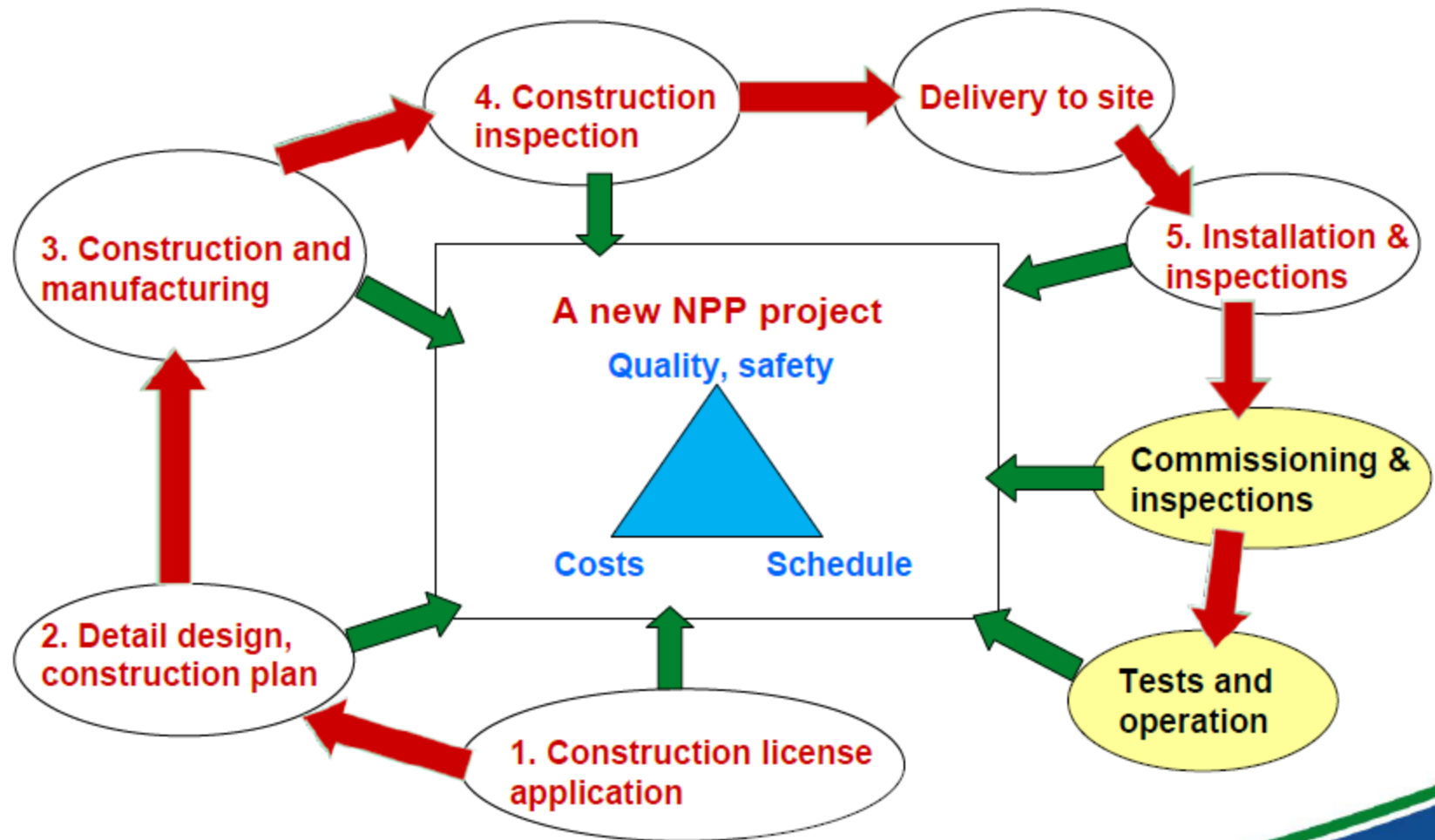
EXCEL Support and Solutions

Support to – Regulators (6)

- **Example: Nuclear Regulatory Organization to be built up with key milestones (T = NPP Contract Award Date):**
 - Regulator setup must begin at T - 12 months, after an initial preparation period of up to 6 months. Nuclear Regulation development takes ~ 18 - 24 months ~ T+ 12 months.
 - At T + 12 months: Expect to receive Site Permit and Construction License Application (CLA). Review takes ~18 to 24 months, ~60 experts + selected TSO support.
 - Final Regulator staff size (~ 120 – 200) at Operating License Application at T + 60 months and Commercial Operation Date COD at ~ T + 96 months.
 - Above estimates depend on actual local conditions and “staff in training” is additional to above numbers.

EXCEL Support and Solutions

Support to – Regulators (7)





EXCEL Support and Solutions

Support to – Regulators (8)

- **EXCEL** is a unique Nuclear Engineering and Licensing Consultancy, and its Experts all bring experience from a successful career, typically 20-40+ years at Western NPP Vendors or Utilities
- **EXCEL** Experts are experienced in licensing of all Gen-II and Gen-III/III+ new build Projects, including ongoing SMR Projects (e.g., mPower, NuScale)
- **EXCEL** Experts (in their former career) have been managing VVER1000 (Temelin-1/2) licensing, construction and operation based on USNRC Regulations
- **EXCEL** is supporting Clients/Regulators in most major Nuclear Countries worldwide



Nuclear Regulations – International Developments

**EXCEL SUPPORT OF INTERNATIONAL
DEVELOPMENTS IN NUCLEAR REGULATIONS
FOCUSED ON OWNERS/OPERATORS**



EXCEL Support and Solutions

Support to – Owners/Operators

- Develop a “Strategic Plan/Road Map” for NPP Program
- Build up “Intelligent Customer” organization
- Implement robust QA (top down) from the beginning
- Site selection process – EIA (incl Safety Analysis)
- Evaluate Financing Options and Business cases
- Review world wide EPC Best Practices
- Select Technology / Vendor and issue RFP
- Get support for NPP / EPC Contract negotiations



EXCEL Support and Solutions

Support to – Owners/Operators (2)

- Select and contract OE to support NPP Project
- Develop CL Application – incl. PSAR and PRA
- Develop Decommissioning Plan
- Develop Emergency Planning
- Construction Oversight and Vendor Inspections
- Tools for Project Management & early detection of issues
- Develop OL Application
- Develop Startup and Commissioning process
- Obtain Operating license



EXCEL Support and Solutions

Support to – Owners/Operators (3)

- Digital I&C systems
- Normal operation oversight / inspections / enforcement
- Fuel cycle optimization
- Reload fuel license
- Waste management oversight
- Power Uprate and Life extension
- Assistance with resolution of operational problems
- Capability of responding to a major crisis



EXCEL Support and Solutions

Support to – Owners/Operators (4)

OTHER EXCEL SUPPORT:

- Support/conduct Peer reviews
- Introducing Nuclear Knowledge Management (NKM), incl associated Training and establishing Communities of Practice
- Safety Culture Training and support
- Security (Physical, Cyber)
- Audit assessments & reviews



EXCEL Support and Solutions

Support to – Owners/Operators (6)

CONCLUSIONS

- **Over past 30 years EXCEL has provided TSO services to almost all U.S. Utilities.**
- **Today, EXCEL is focusing on providing TSO services to REGULATORS and/or OWNERS / OPERATORS in emerging new nuclear countries**
- **EXCEL (and our Partners) can support all TSO assignments required.**
- **EXCEL can also „manage“ other TSO's in support of Regulators and/or Owners**



QUESTIONS?



Thank You!



SERVICES CORPORATION
Nuclear Engineering Consulting

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