Development of SAMG and its implementation in China

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2. Status of SAMGs in China
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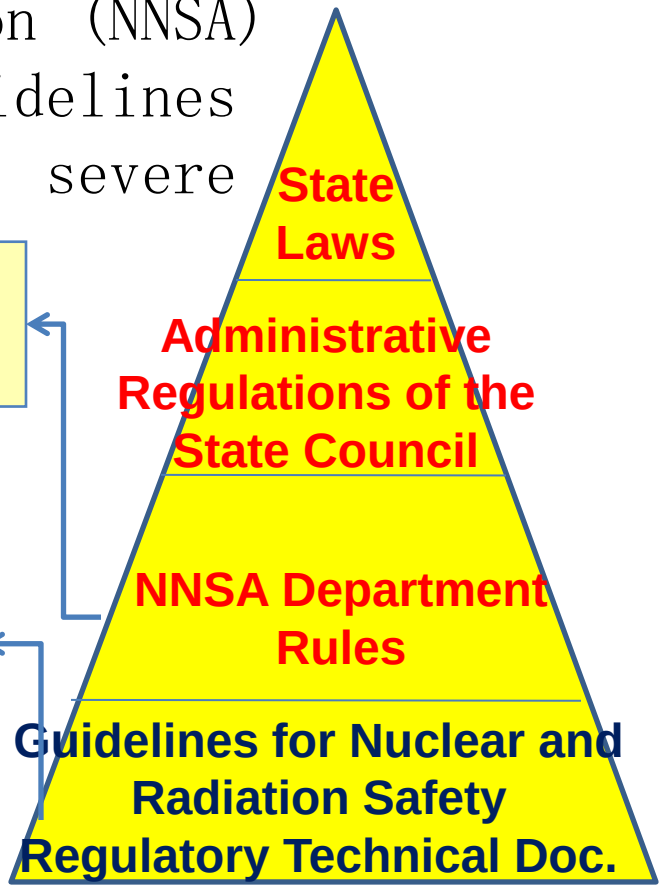
SAMG regulatory requirements in China

National nuclear safety administration (NNSA) issued a series of regulations, guidelines and policy statements for the severe accident management (SAM):

- HAF 102 Safety of Nuclear Power Plants: Design
- HAF 103 Safety of Nuclear Power Plants: Operation

- HAD 102/17 "Safety Assessment and Verification for Nuclear Power Plants"
- "Severe Accident management programme for NPP" (DRAFT)



New policy relative to SAMG after Fukushima nuclear accident

- **12 Five-year Plan and 2020 long-term goal for nuclear safety and radioactive pollution prevention and control**
  - Improve the safety of **operating NPPs**: The SAMG should be completed and implemented before the end of 2013. The survivability of equipment and systems used to mitigate the accident, and the hydrogen explosion should be evaluated, the improvement should be implemented according to the result.
  - Improve the safety of **NPPs under construction**: The SAMG should be completed and implemented before first load, including all accident situations and multi-unit sites, the survivability and accessibility of important equipment and instrument should be analyzed and evaluated under severe accident.

New policy relative to SAMG after Fukushima nuclear accident

- **New Safety Requirements for Newly Built NPPs** (DRAFT)
  - SAMG (including spent fuel pool SAMG) or other accident procedures should be developed, for the severe accidents at power , low power and shutdown mode, and due to external events which lead to widespread destruction should be considered
  - The survivability and accessibility of items in severe accident conditions must be properly considered
  - Staff training programs need to be developed and implemented effectively
  - Verification should be carried out to confirm the correctness and effectiveness of SAMG
  - SAMG should be revised periodically.

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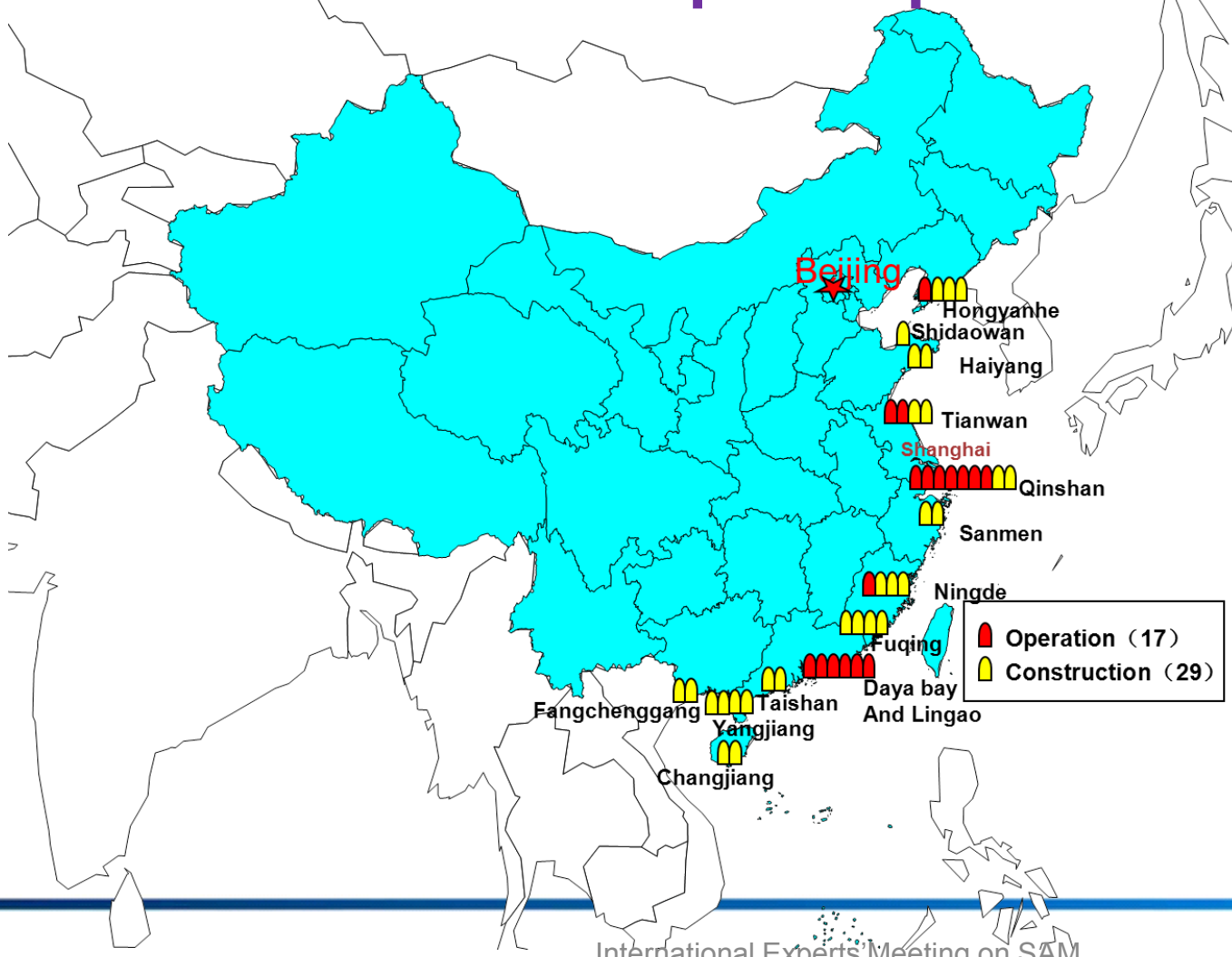
Overview of nuclear power plants in China



- M310+
- CPR1000
- AP1000
- EPR
- VVER
- CNP600
- CANDU
- HTR-PM

Status of SAMG of operating NPPs

Nuclear power plants		at-power SAMG	Shutdown SAMG and Spent Fuel Pool SAMG
Qinshan NPP		D & I*	Plan to do
Daya bay NPPs	1-2 Units	D & I	Developing
Qinshan II NPPs	1-4 Units	D & I	Developing
Lingao NPPs	1-4 Units	D & I	Developing
Qinshan III NPPs	1-2 Units	D & I	Plan to do
Tianwan NPPs	1-2 Units	D & I	Developing
Ningde NPP	No.1 Unit	D & I	Developing
Hongyanhe NPP	No.1 Unit	D & I	Developing

* Developed and Implemented

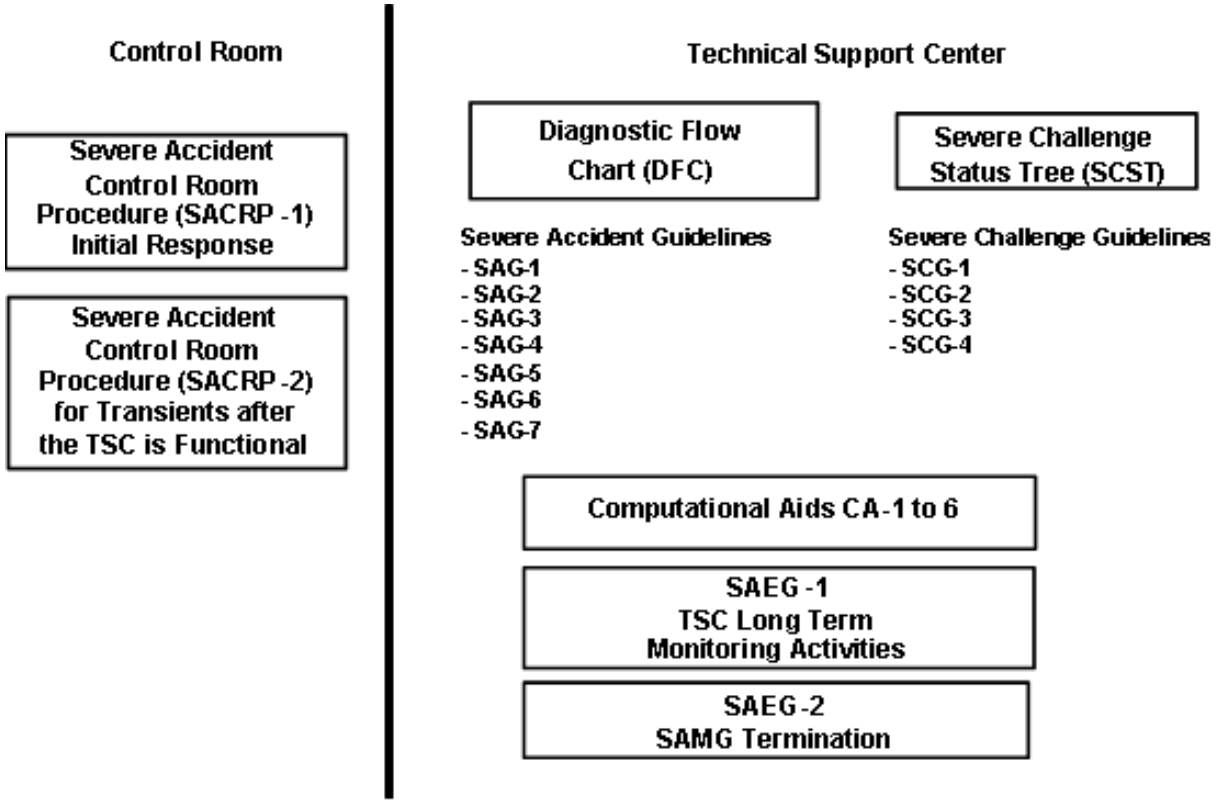
Status of SAMG of NPPs under construction

- at power SAMG will be completed before first load.
- The first training and exercise will be implemented before first load.
- Shutdown SAMG and spent fuel pool SAMG will be completed subsequently.



The SAMG framework

- All NPPs, except EPR, adopt the framework of WOG SAMG, and a lot of validation and revision work have been done.



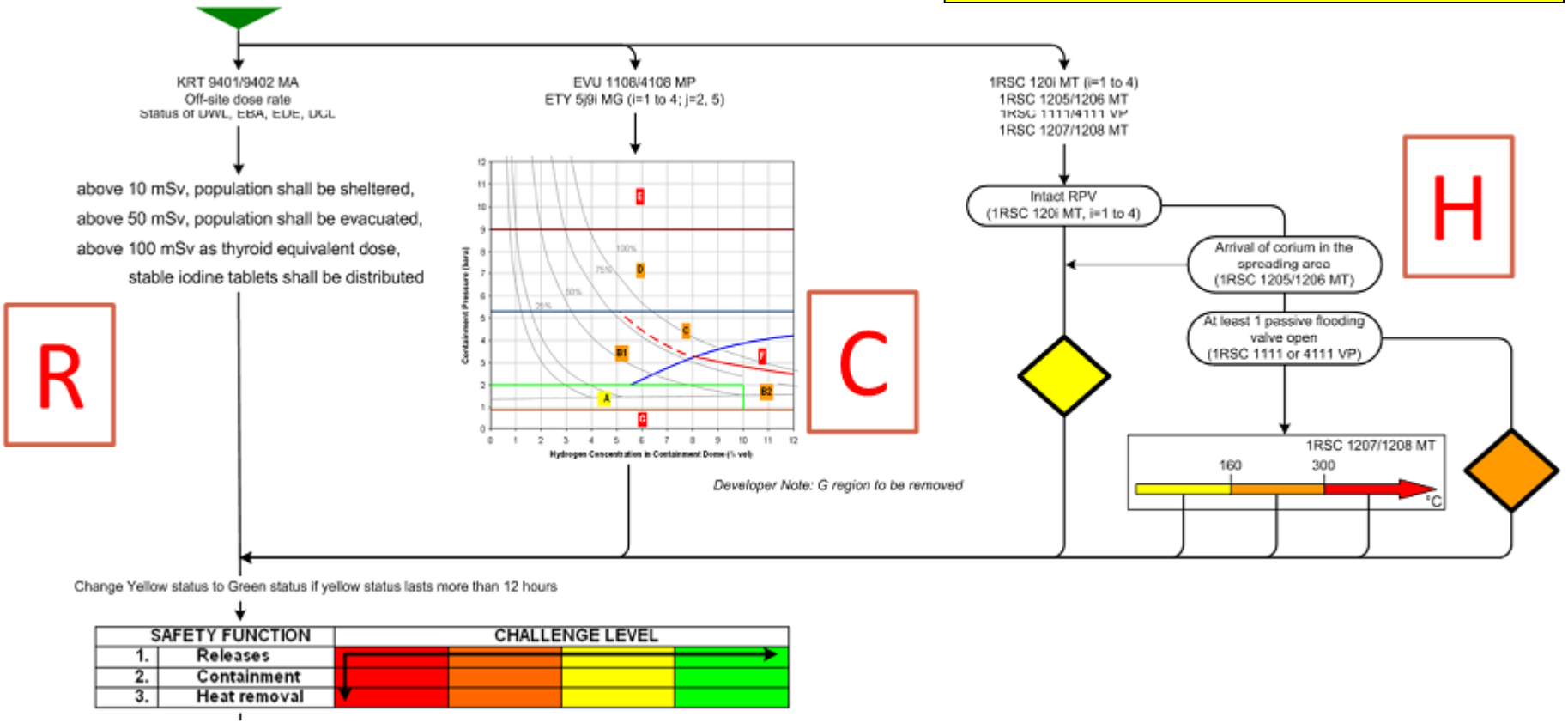
Some Modifications (e.g.)

SAG-1 Inject into the Steam Generators
SAG-2 Depressurize the RCP
SAG-3 Inject into the RCP
~~SAG-4 Inject into containment (Low level Flood)~~
SAG-5 Reduce Fission Product Releases
SAG-6 Control Containment Conditions
~~SAG-7 Reduce Containment Hydrogen~~
SAG-8 Flood Containment

Yang zhiyi,Chong yimin, Li chun et al. *Issues Associated with the Development of Severe Accident Management Guidelines for NPPs in China[C]*, 21th international conference of nuclear engineering. Chengdu, 2013

EPR OSSA Overview

- Three functions
- Four challenge levels



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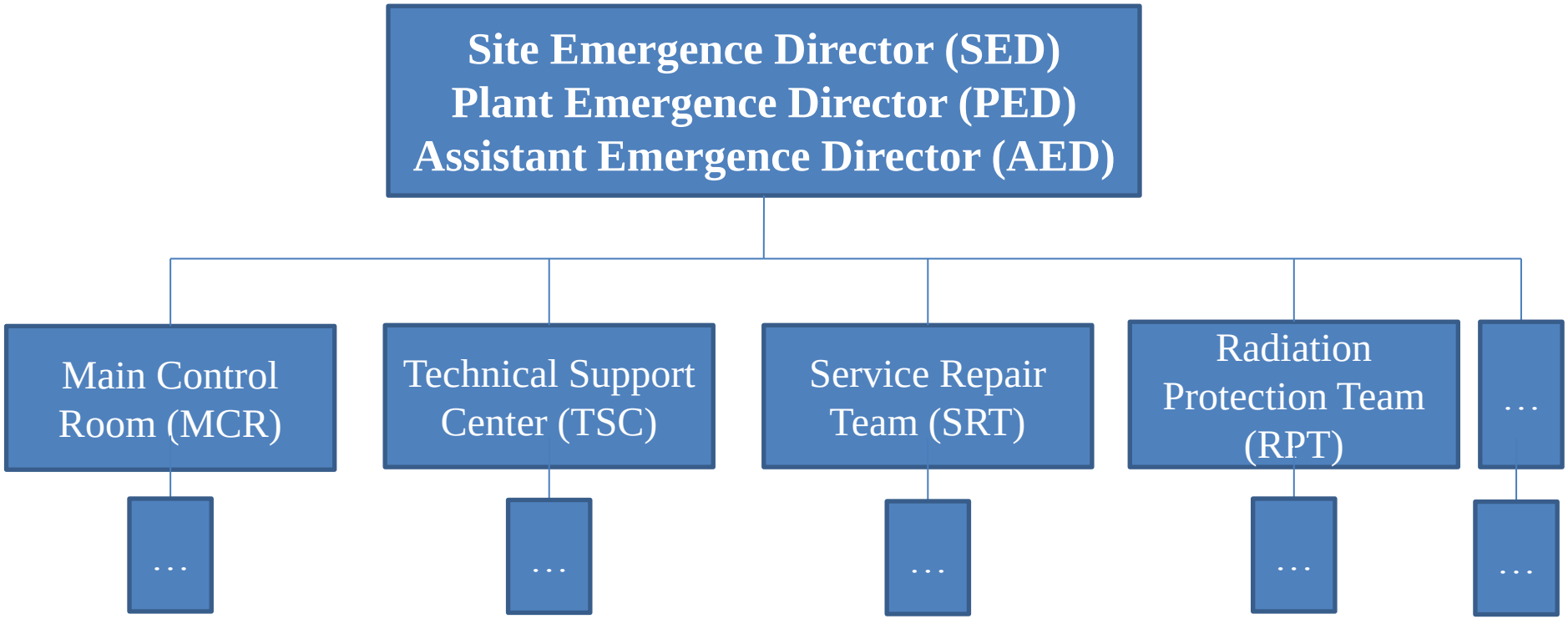
Typical Emergence Organization on-site



Flow of SAMG implement

- Severe accident occurs, CET is greater than 650℃, Transition from EOP to SAMG is suggested by MCR, approved by PED, than SACRG-1 is used by MCR.
- After TSC is functional, SACRG-2 is used by MCR, SAG for DFC and SCG for SCST is used by TSC, Strategies is evaluated and recommended by TSC, approved by PED, including the use of flexible equipment and service repair work.
- The main body of SAMG use is Accident Assessment Team (ATT), part of TSC.
- When parameters criteria of DFC is meet, SAEG-2 is used, SAMG terminated and long term recovery is need.

Matrix of Responsibilities for key SAMG Activities

Action	Evaluate	Recommend	Decision/ Authority	Implement
Transition from EOP to SAMG	MCR	×	PED	MCR
Implement of SACRG	×	×	×	MCR
Severe accident recovery strategies	TSC AAT	TSC leader	PED	MCR
End SAMG and long term recovery	TSC AAT	TSC leader	PED	MCR

Changes of EP due to implement SAMG

- When CET is greater than 650 ℃, “Site Emergence” condition is activated
- The control of accident mitigation is shift to TSC from MCR
- Much SAMG training and exercise work should be done for the TSC and emergence response staff, especially ATT
- The responsibilities of PED is added, entrance/ exit to SAMG, approve of strategies, etc.
- The equipment and instrument modification of TSC, for example, real-time display of reactor parameter

In the next…

- The optimization of SAMG, so it can be more suitable to Chinese plant specific feature
- The low-power and shutdown modes as well as the spent fuel pool SAMG should be completed, Extensive Damage Management Guideline (EDMG) is also needed
- The verification and validation of SAMG, more training and drill work should be done
- Flexible strategy to cope with the Fukushima-like accident, such as flexible pump, flexible power will be considered in SAMG

Conclusion

- In China, especially after Fukushima nuclear accident, SAMG is a regulatory requirement, being completed in most NPPs.

  a) The SAMG regulatory requirements is described;

  b) The status of SAMG in China is concluded;

  c) The implementation of SAMG is introduced;

  d) The work plan of SAMG in next stage is listed.

Thanks for your patience !