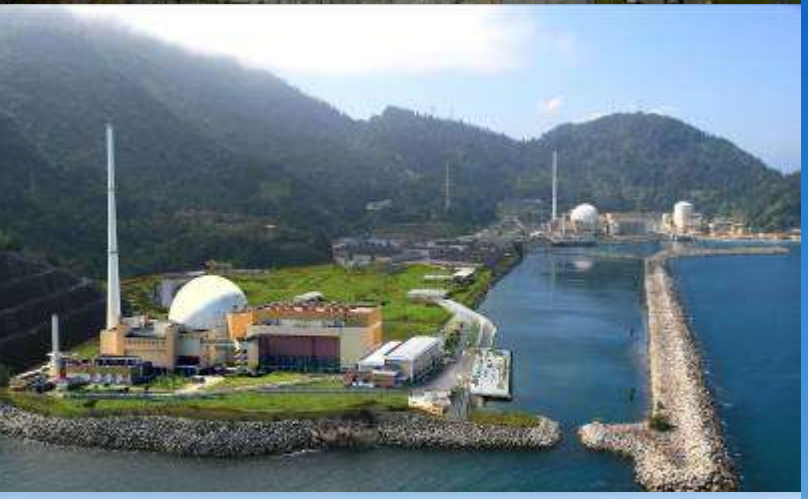

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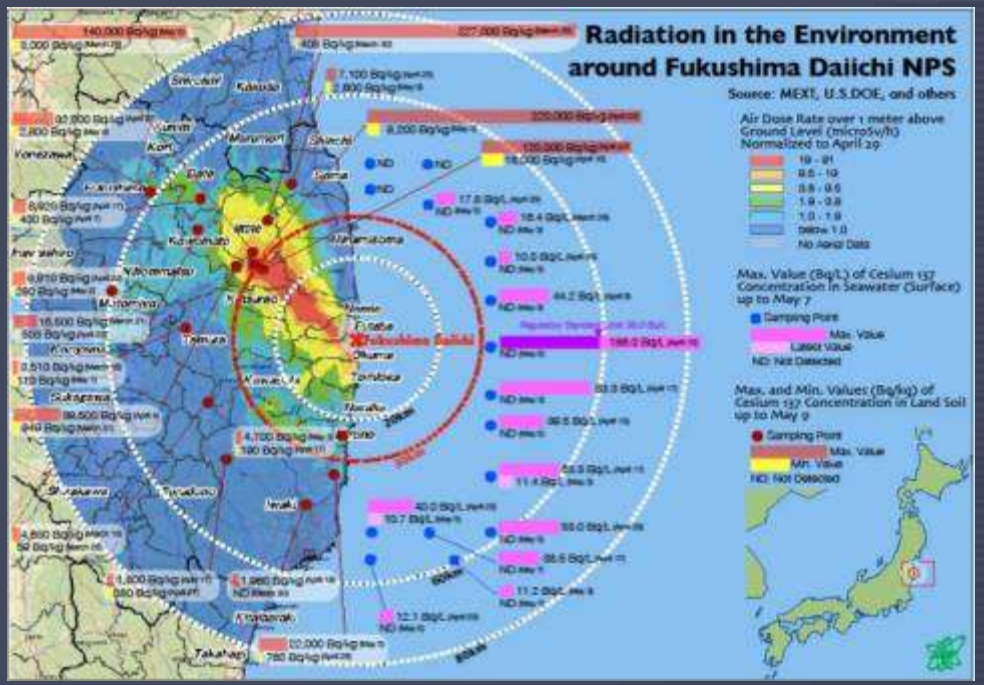
# Updating Nuclear Power Program in Brazil After Fukushima

***LAS-ANS SYMPOSIUM 2012***
***July 3rd 2012***

# FUKUSHIMA BRINGS 2 NEWS

## FOR WORLD NUCLEAR INDUSTRY

*A BAD ONE*



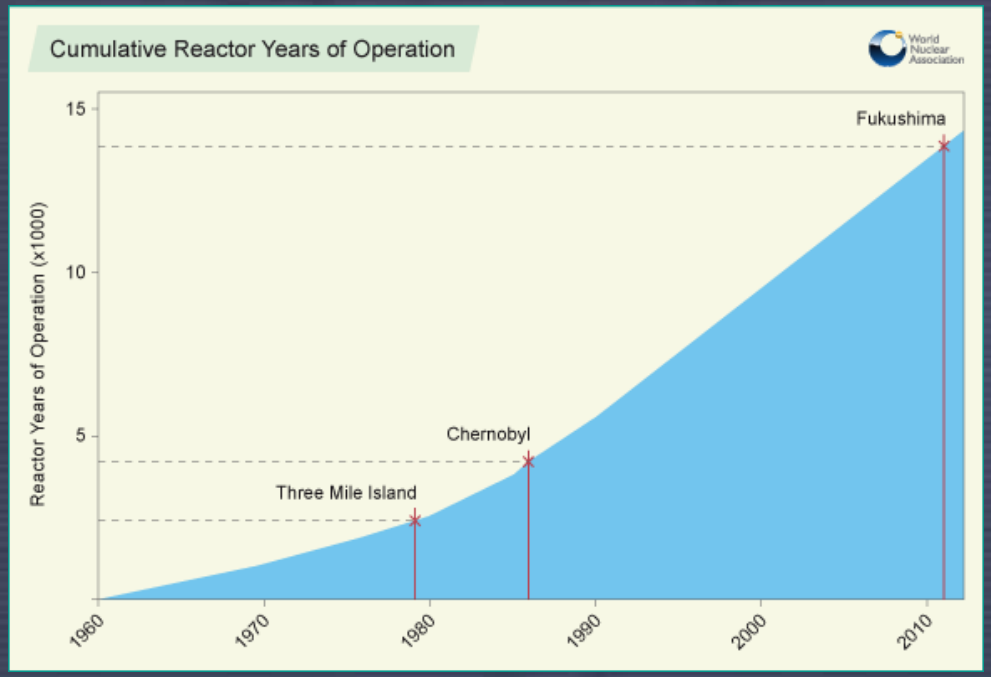

*OTHER*
*NOT SO BAD*

# FUKUSHIMA BRINGS 2 NEWS

## THE BAD NEWS

***SEVERE ACCIDENTS HAPPEN***

***EVEN AFTER ALL POST-TMI, POST-CHERNOBYL AND OPERATIONAL EXPERIENCE FEEDBACK COUNTER-MEASURES***

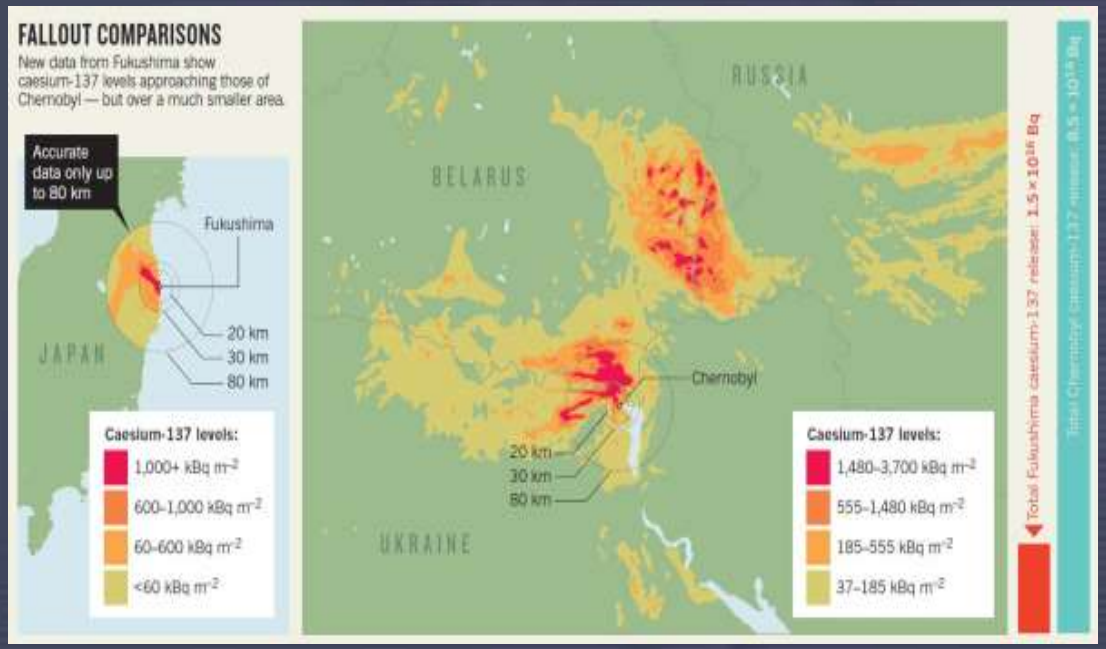


# FUKUSHIMA BRINGS 2 NEWS

## THE NOT SO BAD NEWS


***THEY ARE NOT SO "CATHASTROFIC"***

***THE OBJECTIVELY MEASURED HARM FOR PUBLIC AND ENVIRONMENT CAUSED DOES NOT ADHERE TO THE HYPERBOLIC LANGUAGE OFTEN USED***



# Fukushima Response Plan

## (submitted to Brazilian Nuclear Authority in December 2011)

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**RELATÓRIO**

CLASSE: 3

Nº: P-001/11

ASSUNTO/MOTIVO

**ELETROBRAS ELETRONUCLEAR**
**PLANO DE RESPOSTA A FUKUSHIMA**

(aprovado pela RDE nº 1054.001/11 de 30.11.2011)

PÁGINA: 1 / 44

LOCAL/DATA: Rio, 28.11.2011

REDATOR: Paulo Carneiro

U.O./TEL.: DT / 7053

REFERÊNCIA: CNAAA

CÓDIGO ARQUIVO: P-001/11

| Nº DE PÁGINAS | ANEXOS | (NOS RELATÓRIOS DE REUNIÃO INDICAR, INICIALMENTE, NO SUMÁRIO: LOCAL, DATA, COORDENADOR, PARTICIPANTES E DURAÇÃO) | Para ser providenciado<br>Para conhecimento<br>prazos |
|---|---|---|---|
| 44 | 3 | | |

**Sumário**

A elaboração do **PLANO DE RESPOSTA A FUKUSHIMA** apresentado neste Relatório foi determinada pela Diretoria Executiva, como uma das atribuições do Comitê Gerencial de Resposta a Fukushima, instituído pela CGE nº 038/11 de 20/09/2011.

**56 initiatives (studies and projects)**

**Performance of Stress Tests**

**Around US$ 250 million to be applied from 2011 to 2015**

**High priority inside the organization**

# Fukushima Response Plan

**(submitted to Brazilian Nuclear Authority in December 2011)**

## *General Time Scheduling – Main Events*

| Year | Protection Against Risk Events | Cooling Capacity | Mitigation of Radiological Consequences |
|---|---|---|---|
| 2012 | Conclusion of more relevant site studies (landslides, waves and external flooding) | Conclusion of studies on reactor and fuel pool cooling | Ordering of all systems and equipment for containment atmosphere control |
| 2013 | Conclusion of evaluation of design margins for earthquake | Implementation of mobile equipment for power and water supply (first quarter) | |
| 2014 | Conclusion of all plant interventions related to eternal events | Conclusion of SAMGs implementation for Angra 2<br>Conclusion of all plant interventions related to cooling capacity | Conclusion of Implementation of all systems and equipment for containment atmosphere control |
| 2015 | Conclusion of all initiatives of Fukushima Response Plan | | |

# Fukushima Response Plan

(submitted to Brazilian Nuclear Authority in December 2011)

## *Budget for Plan Execution*

| Plant Unit | Budget for Scope Defined | Cost Estimation for interventions not yet defined | Total |
|---|---|---|---|
| Angra 1 | 25.000.000 | 29.000.000 | 54.000.000 |
| Angra 2 | 23.000.000 | 10.000.000 | 33.000.000 |
| Central | 52.000.000 | 110.000.000 | 162.000.000 |
| **TOTAL** | **100.000.000** | **149.000.000** | **249.000.000** |

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| **Budget for Scope Defined** | 2.000.000 | 16.000.000 | 16.000.000 | 50.000.000 | 16.000.000 |
| **Cost Estimation for Interventions not Defined** | 0 | 2.000.000 | 40.000.000 | 76.000.000 | 31.000.000 |

# Stress Tests for Angra 1 and 2


According to specification issued by Iberoamerican Forum of Regulatory Bodies, Nuclear and Radiological (request from CNEN in January 2012)

**Compliance with WENRA Specification for Stress Tests**

European Commission

**Submitted to CNEN on April 2nd, 2012**

# Stress Tests for Angra 1 and 2

## Evaluation of Loss of Heat Sink Condition

**Favorable Angra conditions:**

- water intake structures in area of protected sea water (Ilha Grande Bay);
- water intake structures protected by jetty 8,0m high above average seawater level;
- very low probability of water intake blockage to the extent of impairing minimum flow for residual heat removal;
- water availability at site enough for long term cooling through steam generators (about 30 hours SG feeding without tank refilling);
- possibility of feeding steam generators by fully passive means (fire fighting system, water reservoir of 6,000$m^3$ at 110m height);

# Stress Tests for Angra 1 and 2

## Loss of Fuel Pool Cooling

### Temperature Increase after Loss of Cooling Function

| Unit | Plant condition | Time until start boiling | Time until fuel element exposure |
|---|---|---|---|
| Angra 1 | Power Operation | 18h | 190h |
| | Refuelling (*) | 9h | 63h |
| Angra 2 | Power Operation | 23h | 155h |
| | Refuelling (*) | 5h | 35h |

(*) limit condition, full core unloaded and full occupation of pool racks

# Stress Tests for Angra 1 and 2

## Coping with SOB and LUHS: Additional Means

**Under final dimensioning and specification:**

- one mobile diesel generator for each unit as alternative power supply for safety systems (~ 1,000 to 1,800kVA);
- one mobile diesel generator for each unit for batteries reloading and supply of small components (borating pump)(~250kVA);
- two mobile water pumps for each unit as an alternative mean for feeding the steam generators (27kg/s and 75m);
- two mobile water pumps for each unit for refilling water reservoirs and pools (20kg/s and 20m);
- one mobile air compressor for Angra 1 as an alternative mean for remote actuation of main steam and feedwater valves;
- mobile fuel pool cooling unit for Angra 1 (design only one train)

# Stress Tests for Angra 1 and 2

## Mitigation of Consequences

***Severe Accident Management Guidelines - SAMG***

- Angra 1 SAMG prepared based on standard PWR SAMG developed by Westinghouse Owner's Group; plant personnel training on going;
- Angra 2 SAMG under preparation by AREVA;
- state of art of Westinghouse Owner's Group and AREVA SAMG does not consider lessons learned from Fukushima;
- revision of Angra 1 SAMG for incorporating Fukushima experience after reevaluation by "PWR Owners Group" is available;
- Angra 2 SAMG will already consider at least partially mitigation strategies under implementation on Angra 2;
- contracting of containment venting and H2 recombiners on going;

# Stress Tests for Angra 1 and 2

## Management of Emergency Conditions

***Local Emergency Plan complies with Brazilian and international requirements;***

**the following opportunities for improvement have been addressed:**

- improvement of communication between Emergency Centers;
- construction and enlargement of wharfs in the vicinity of the plant (sea transportation of personnel, equipment and materials);
- modification of radiological protection procedures for application in severe accident conditions (participation in the initiative of ISOE/NEA/OECD/IAEA).

# DECENIAL ENERGY PLAN 2020

## No changes for Angra 3, but no new build

ANGRA 3: 1.405 MW AREVA PWR




**ANGRA 3**
**1.405 MW**
**2015**


Gráfico 18 – Acréscimo de Capacidade Instalada Nuclear (MW)

# NATIONAL ENERGY PLAN 2030

## 1 - 2 year delay minimum

1. **Update 2035 (more nuclear?)**
   - Was not be presented in 2011, as planned – only this year
2. **Candidate areas National Atlas**
   - Would be presented May 2011
   - Will not be presented in 2011, as planned – only in 2012 (?)
3. **Site selection field works**
   - Would be started end 2011
   - Delayed (2013?)

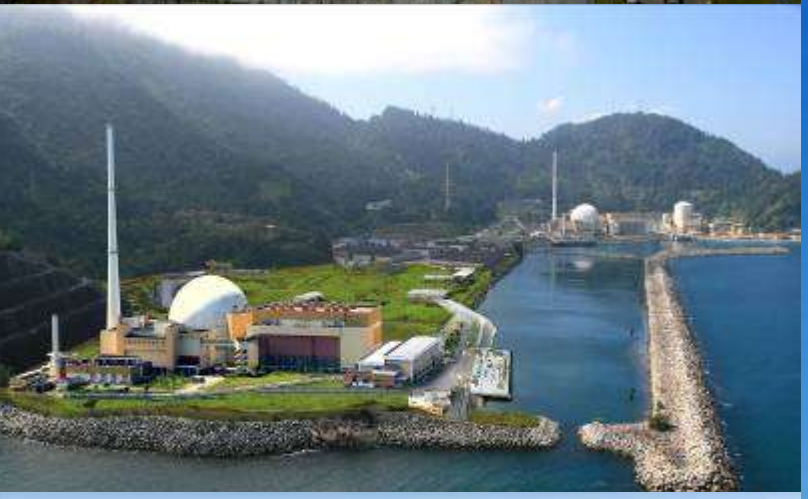

PLANO NACIONAL DE ENERGIA 2030

**NUCLEAR POTENTIAL ATLAS**
*40 CANDIDATE AREAS*

| 2016-2020 | 2021-2025 | 2026-2030 | 2016-2030 |
|---|---|---|---|
| 1.000 MW NE 1 | 1.000 MW NE 2 | 2.000 MW SE 1+SE 2 | 4.000 MW |

1) **Northeast** 2.000 MW

2) **Southeast** 2.000 MW



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# Thank you!

*LAS ANS SYMPOSIUM 2012*
*July 3rd 2012*