“ Niigata-Chuetsu-Oki Earthquake of 16 July 2007 and Kashiwazaki-Kariwa NPP -FINDINGS AND LESSONS LEARNED”

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OBJECTIVES

- Conduct a fact finding mission
- Identify lessons learned for such event
- Discuss the performance of the nuclear power plant units under the earthquake, and fulfilment of the fundamental safety functions:
  - control of reactivity;
  - removal of heat from the core; and
  - confinement of radioactive materials

SCOPE OF THE MISSION

– Comparison of the seismic design basis of the plant with the observed ground motion.
– Observation of the damages as consequence of the earthquake of 16 July 2007.
– Operation management during and after the earthquake.

THE EARTHQUAKE

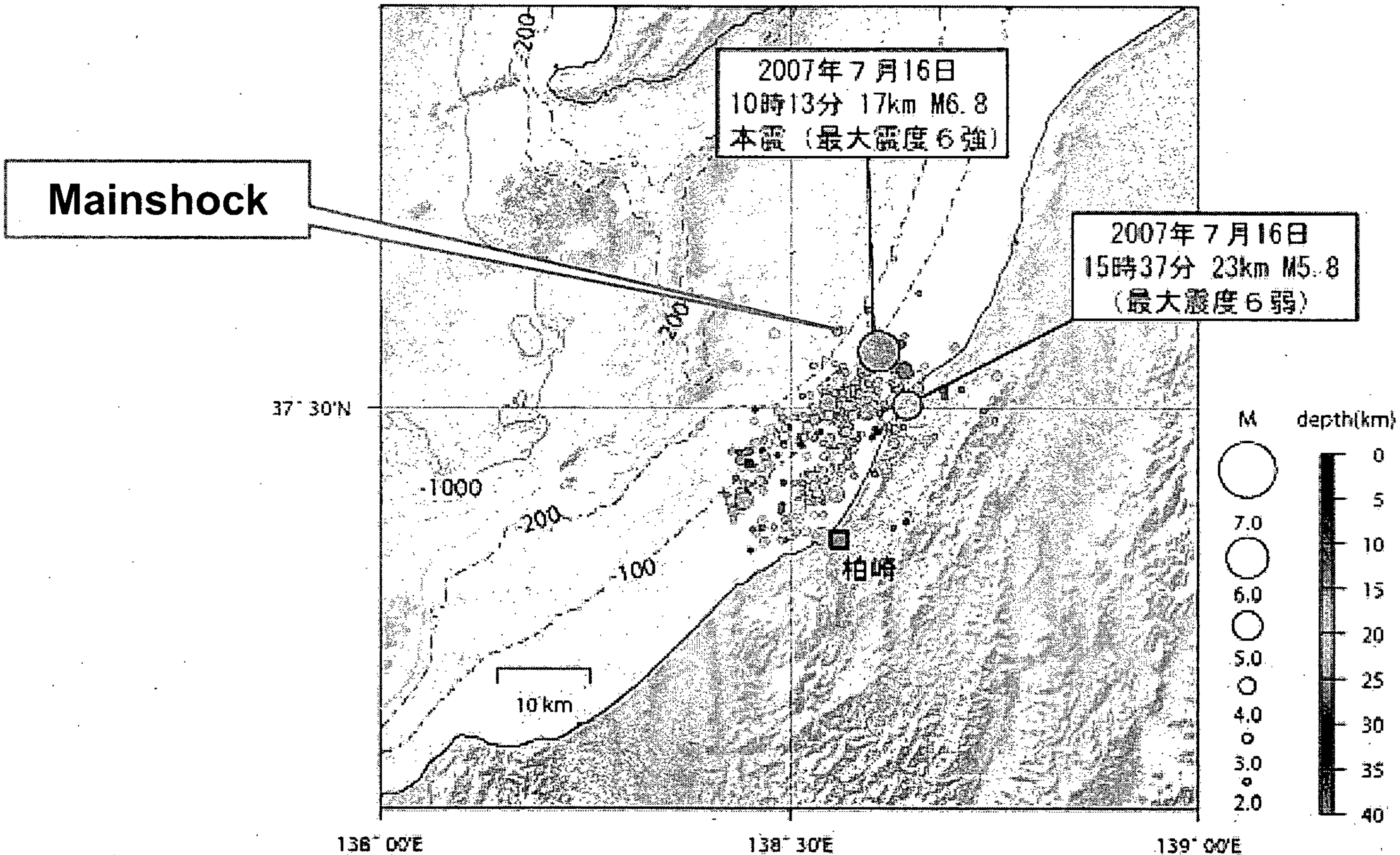
Main shock:

- Moment Magnitude: 6.6
- Epicentre: N37.5 , E138.6
- Time: 16 July 2007, 10:13(JST)
- Depth: 17 km
- Distance to KK NPP:
  - Epicentre: 16 km
  - Hypocentre: 23 km

DISTRIBUTION OF MAIN AND AFTERSHOCKS

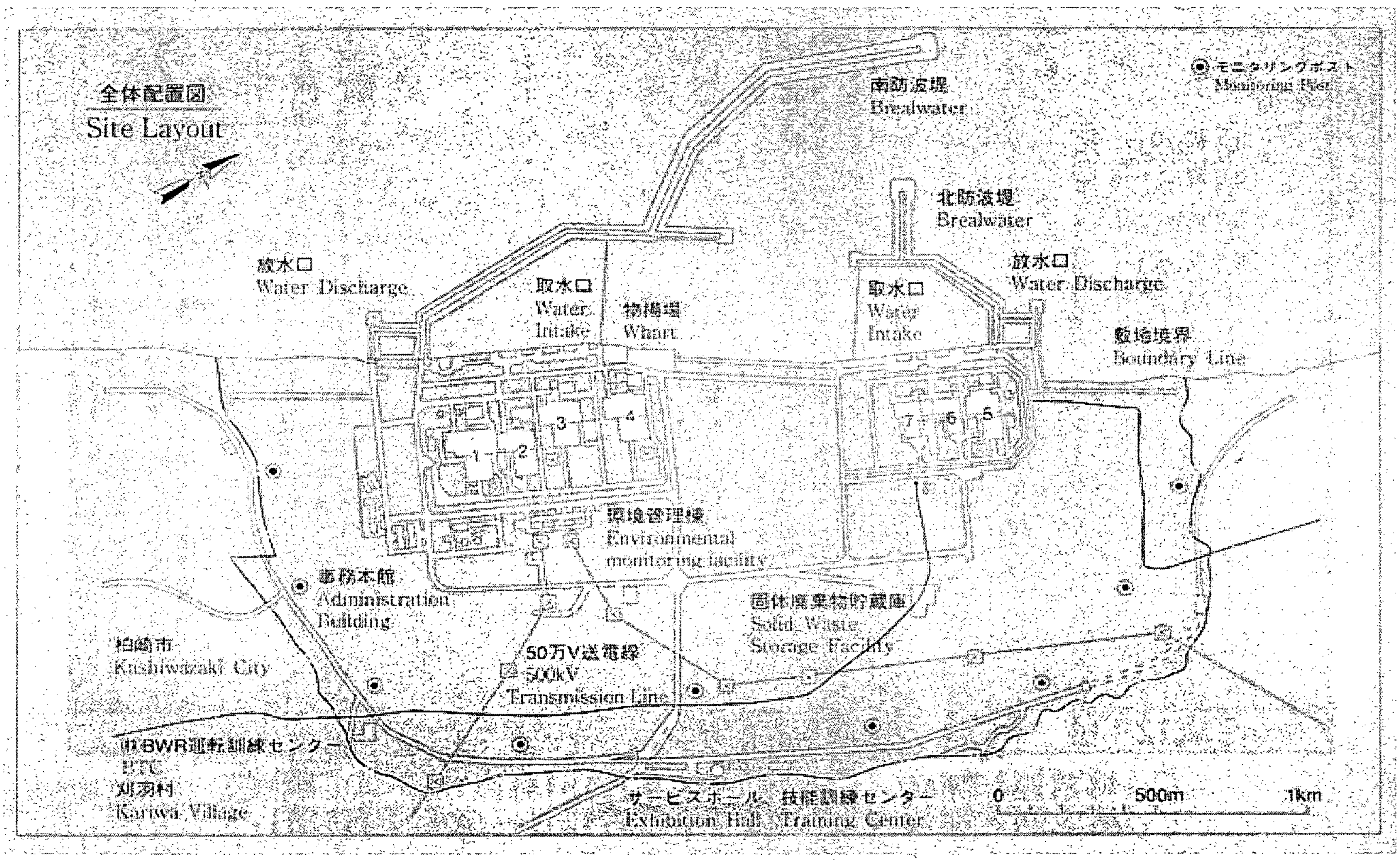
2007年７月20日７時現在

震央分布図（2007年７月16日以降、深さ40km以浅、M≧2.0）



丸の大きさはマグニチュードの大きさを、色は震源の深さを表す。
地形データには国土地理院の数値地図50mメッシュ（標高）および日本海洋データセンターのJ-EGG500を使用。

MAP OF KK NPP



全体配置図
Site Layout
南防波堤
Breakwater
北防波堤
Breakwater
モニタリングポスト
Monitoring Post
放水口
Water Discharge
取水口
Water Intake
物揚場
Wharf
取水口
Water Intake
放水口
Water Discharge
敷地境界
Boundary Line
1
2
3
4
5
6
7
環境管理棟
Environmental monitoring facility
事務本館
Administration Building
固体廃棄物貯蔵庫
Solid Waste Storage Facility
柏崎市
Kashiwazaki City
50万V送電線
500kV Transmission Line
BWR運転訓練センター
BTC
刈羽村
Kariwa Village
サービスホール、技能訓練センター
Exhibition Hall, Training Center
0
500m
1km

OUTLINE OF of KK NPP

Total output

8,212 MW

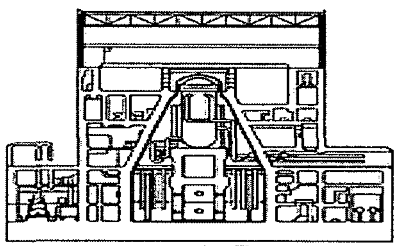
BWR : 5 units

ABWR : 2 units

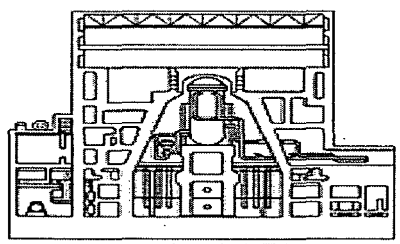
設備の概要 | 沿　革 | アクセス | 資料画像

柏崎刈羽原子力発電所　設備の概要

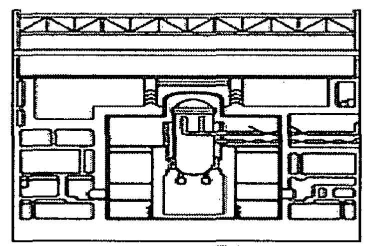
			1号機	2号機	3号機	4号機	5号機	6号機	7号機
プラント主要諸元	電気出力(万kW)		110.0	110.0	110.0	110.0	110.0	135.6	135.6
	建設着工		1978/12	1983/10	1987/7	1988/2	1983/10	1991/9	1992/2
	営業運転開始		1985/9	1990/9	1993/8	1994/8	1990/4	1996/11	1997/7
	原子炉形式		沸騰水型軽水炉(BWR)						
	格納容器形式		マークⅡ	マークⅢ改良				鉄筋コンクリート製(ABWR)	
	国産化率(%)		99					89	
	主契約者		東芝			日立		東芝 日立 GE	日立 東芝 GE
原子炉	熱出力(万kW)		329.3					392.6	
	燃料集合体数(体)		764					872	
	燃料集合体全長(m)		約4.47						
	制御棒本数(本)		185					205	
	圧力容器	内径(m)	6.4					7.1	
		全高(m)	23					21	
		全重量(t)	750					910	
	格納容器	全高(m)	約48					約36	
		直径(m)	26	29					
		圧力抑制室プール水量(t)	3,300	4,000				3,600	
タービン	回転数(rpm)		1,500						
	入口蒸気温度(℃)		282					284	
	蒸気圧力(kg/cm2g)		66.8					68.2	
燃料	種類		二酸化ウラン						
	ウラン装荷量(t)		132					150	
	燃料集合体(本)		764					872	



マークⅡ型



マークⅢ改良型



ABWR型

※各型のイラストの大きさの比率は一致していません。

PLANT PERFORMANCE

- Approximate number of incidents itemized by TEPCO
  - –Total 1275
  - –Identified, translated addressed 68
  - –Reportable 10

PLANT PERFORMANCE

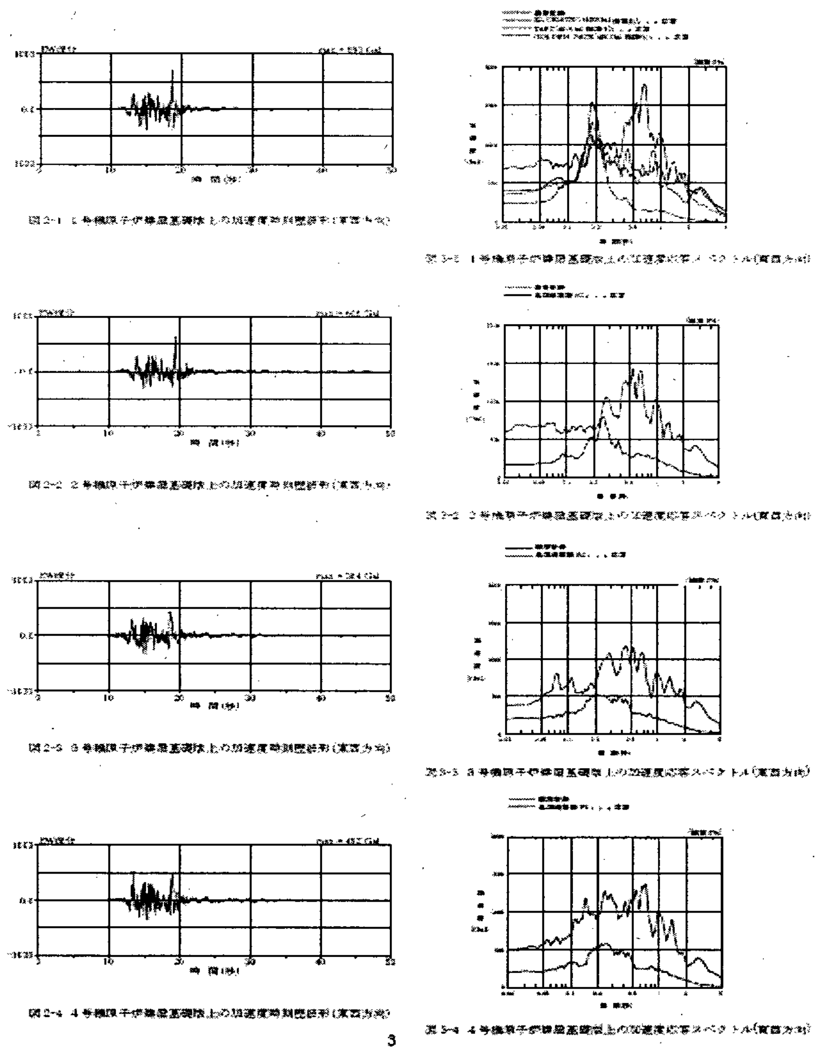
- Design basis ground motion largely exceeded
- Satisfactory behaviour during and after the earthquake
- Safety functions preserved
  - very small releases observed
- Conservatism in the design compensate the uncertainties in the data/methods at the time of design

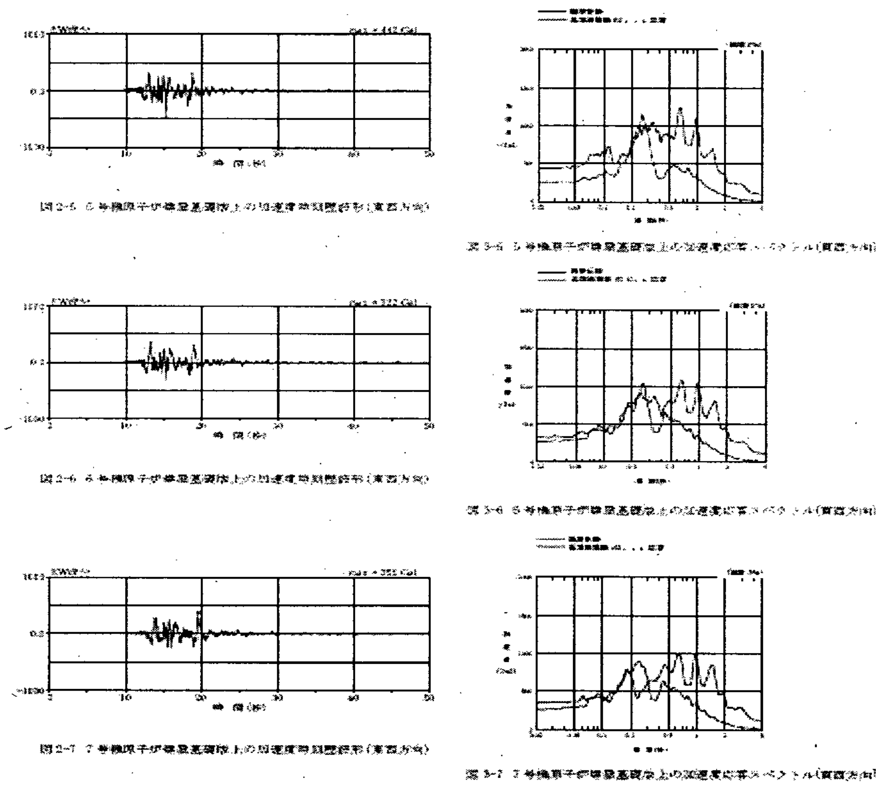
FREE-FIELD SURFACE ACCELERATIONS approx. 1 g PGA

Kashiwazaki-Kariwa Nuclear Power Plant (7 Units)

Unit	Observed Maximum Acceleration Top of RB Basemat (-45m)			Design Values (S2)
	NS	EW	UD	NS/EW
1	311	680	408	274
2	304	606	282	167
3	308	384	311	192
4	310	492	337	193
5	277	442	205	249
6	271	322	488	263
7	267	356	355	263

SEISMIC WAVE AND RESPONSE SPECTRUM (ACCELERATION)





Observation — Design (S_2)

On the Foundation of R/B

PLANT PERFORMANCE

- In-structure responses compared for a very limited sample
  - Forces
  - ISRS at one location in RB #3

PLANT PERFORMANCE

- No LOSP (2 of 4 transmission lines always available)
- Soil failures
  - Generally, non-safety consequences
  - Fire protection piping failure led to water and soil intrusion in RB 1
- Fire fighting capability -
  - Lost water sources
  - Delayed off-site fire brigade

PLANT PERFORMANCE

- Seismic systems interaction
  - Falling
    - Control room ceilings Units 6,7 and 3
    - “Temporary” platform in spent fuel pools
  - Flooding
    - Sloshing spent fuel pools (Video Unit 6)
    - Fire suppression piping (RB 1)
    - Condenser (rubber connection failure)

PLANT PERFORMANCE

- Anchorage failures (non-safety water tanks)
- Very small releases
  - Air due to operator air
  - Sloshed water leaked into non-control area - pumped into the sea

PLANT PERFORMANCE

- Correlated failure modes/common cause
  - Control room ceiling light fixtures
  - Ducts to stack
  - Spent fuel pool maintenance platforms

OPERATIONAL MANAGEMENT

- Defense in depth (normal operating plant without actuation of safety systems)
- Readiness for operation (testing of safety systems under way)
- Reporting to authority (could have been quicker?)

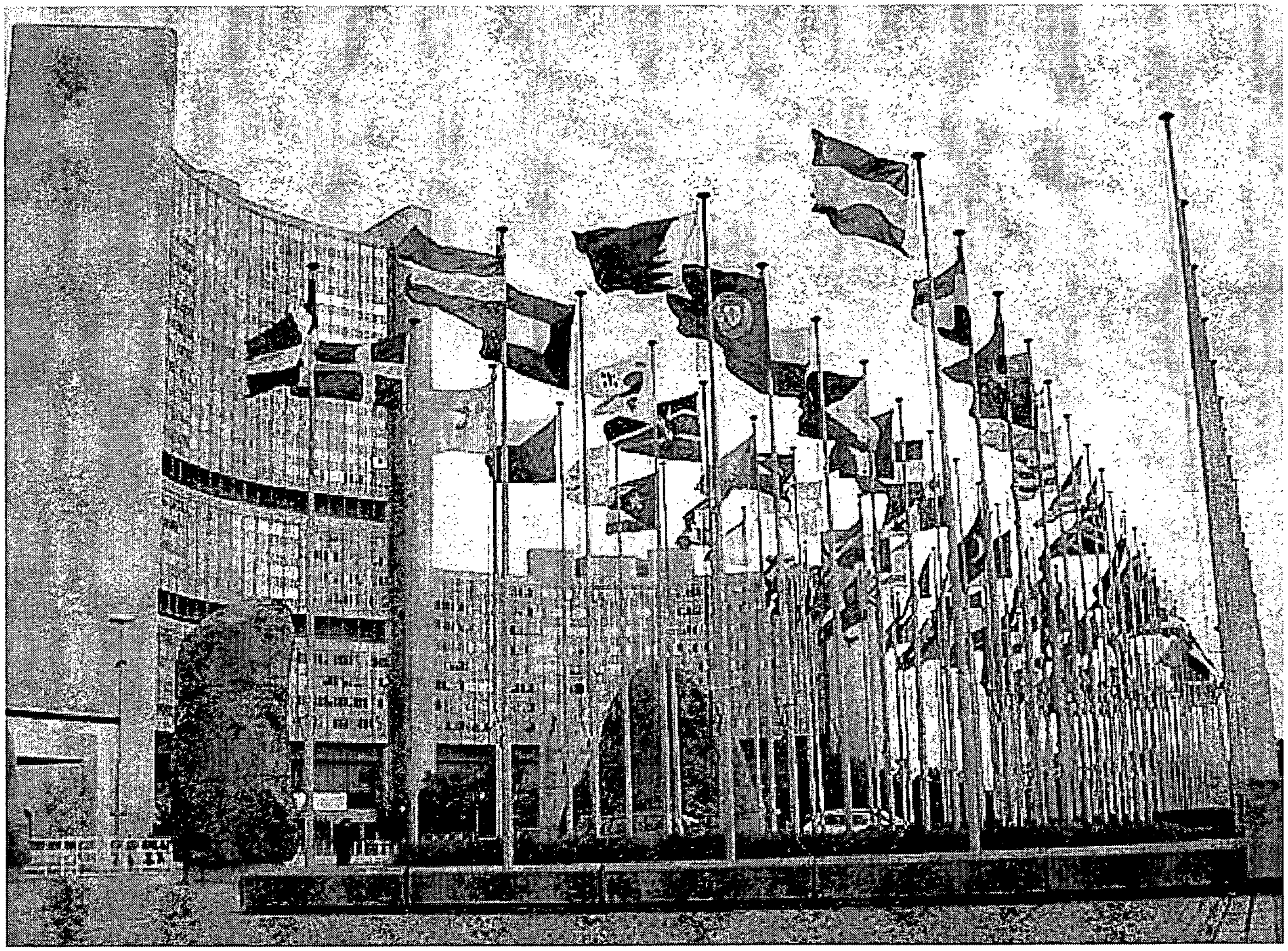
RESTART of PLANT

- Seismic hazard re-evaluation (including identification and characterization of capable/active faults)
- Detailed check of integrity and operability of all safety systems (under way)
- Re-evaluation of seismic safety in relation with the new hazard
- Potential interaction between large ground motions and accelerated ageing

RELATION WITH THE JAPANESE COUNTERPART

- Japanese Counterpart open and cooperative.
- All questions addressed promptly and documented
- Transparency to the international community

INTERNATIONAL ATOMIC ENERGY AGENCY



Thank you for your attention