Experience of the JCO Criticality Accident

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Points

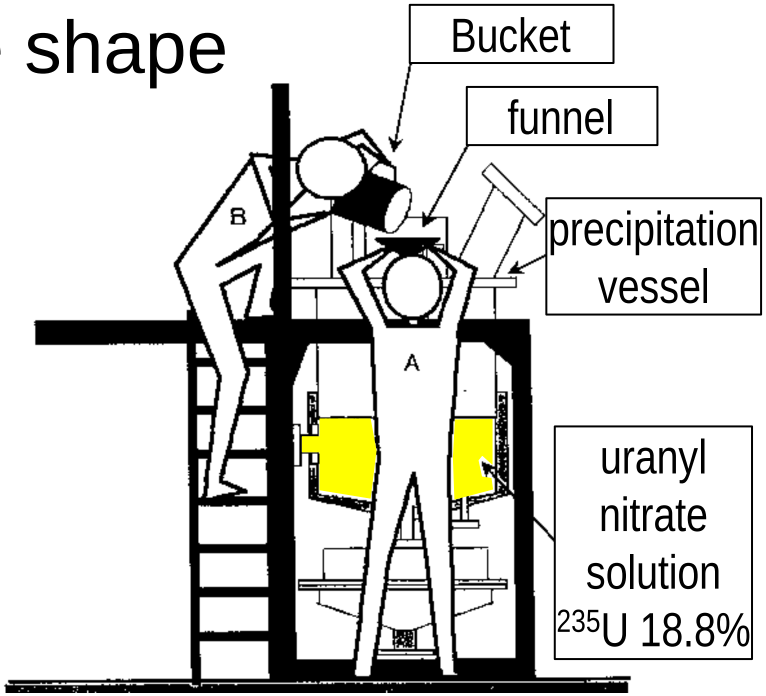
- What we assessed and prognosticated
  - A criticality accident really has occurred?
  - How is the criticality?
  - How can we terminate it?
  - How should the public behave?
- Review of the judges
  - Fission chain reaction, adequately judged
  - Social actions, insufficient technical base

Criticality Accident Really Has Occurred?

- First word (~ 12:00)
  - radioactive material release?
  - chemical accident of fluoride?
- News media report (~ 13:00)
  - criticality accident (casualties, blue flush light)?
- Voluntary mobilization of specialists (~ 15:00)
  - facility/equipment failure?
  - unknown condition of fissile material?

How Is Criticality?

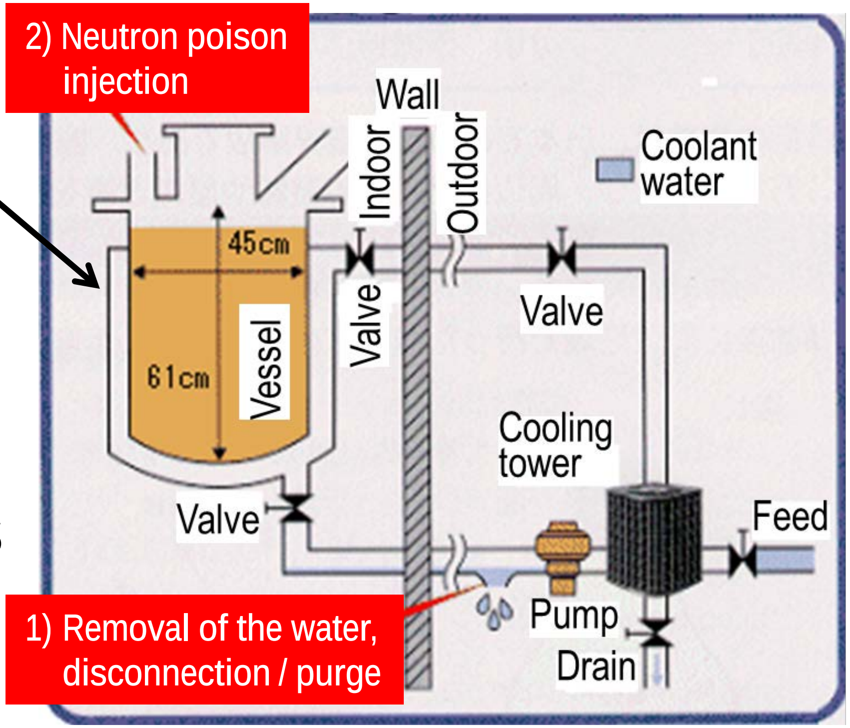
- First detail information (~ 15:00)
  - intentional manual feed of fissile solution
  - into a vessel with an unsafe shape
- Immediate judges
  - sustaining criticality
  - inevitable intervention
- Confirmation (~ 16:30)
  - neutron measurement (> 4 mSv/h)



NSC INVESTIGATION COMMITTEE, "The report of the uranium processing plant criticality accident," Nuclear Safety Commission, STA, Japan (1999) (in Japanese)

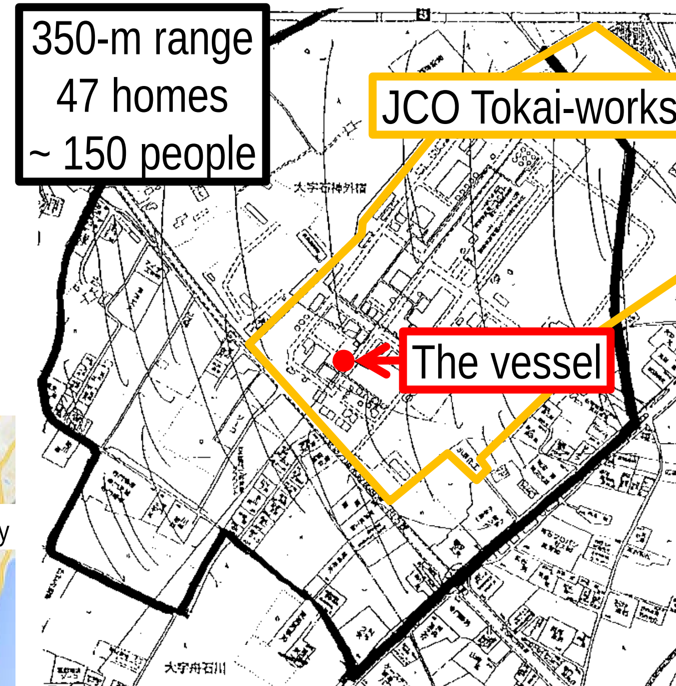
How Can We Terminate It?

- More detail information: cooling water
  - jacket of the vessel
  - circulation
- Removal of the water
  (the next day 2:30~6:15)
  - disconnection of piping
  - purge by compressed gas
  - neutron monitoring
- Neutron poison injection
  (the next day ~8:50)



How Should Public Behave?

- 350-m range
  - γ-rays and neutrons from fissions
  - evacuation (12:30~)
- 10-km range
  - γ-rays from released FPs
  - no immediate risk
  - indoor sheltering



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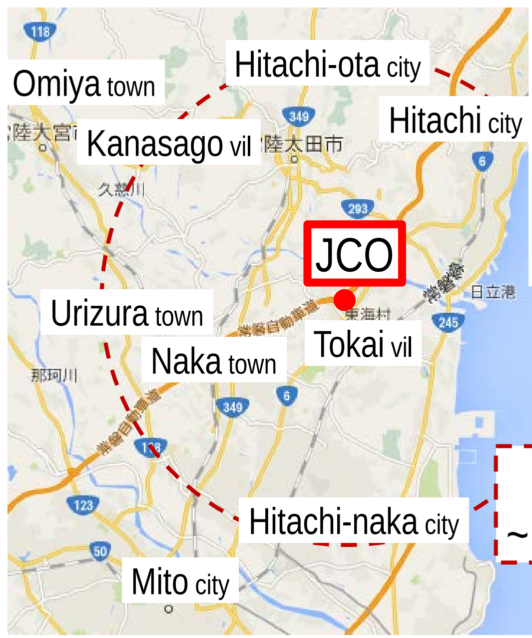

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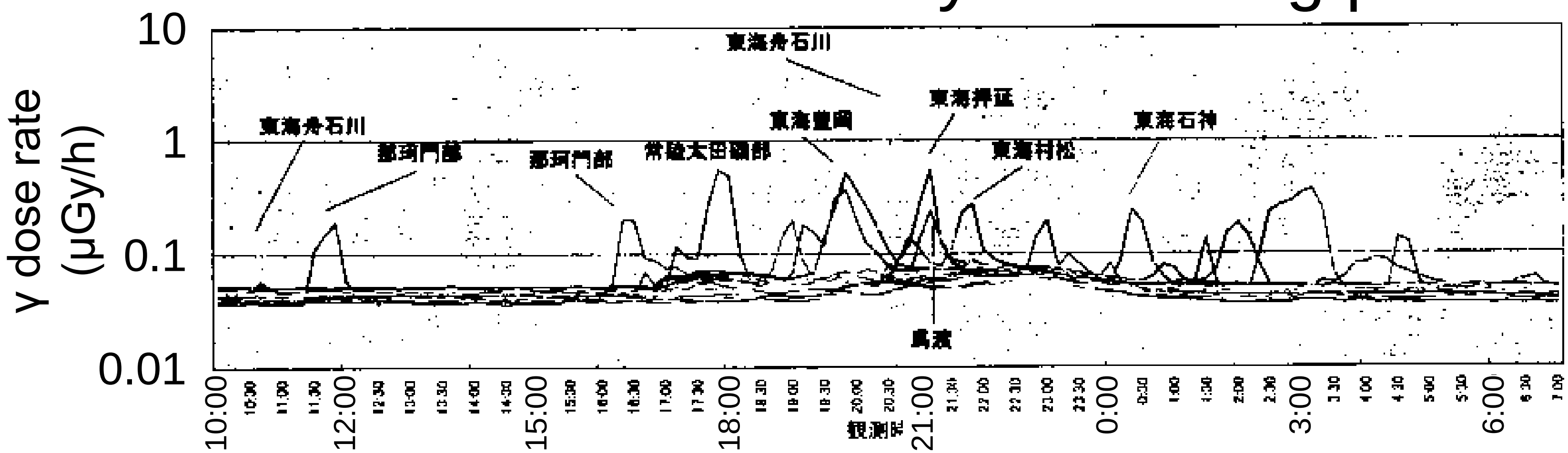
Fission Chain Reaction, Adequately Judged

- No unknown information of fissile material
  - composition, quantity, location, etc.
- Ongoing TRACY experiment program
  - simulation of criticality accident using uranyl nitrate solution
- ICNC (September 20-24, 1999)
  - opportunity of a case study of criticality accidents

Social Actions, Insufficient Technical Base

- The indoor sheltering
  - just because of the slight increase of dose rates detected by monitoring posts

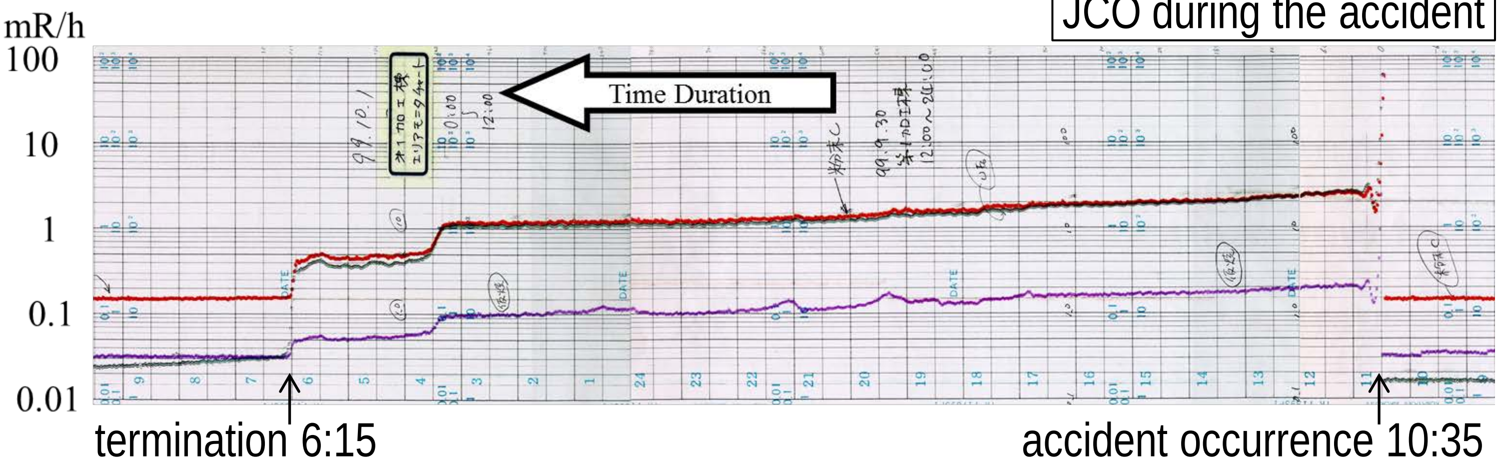


NSC INVESTIGATION COMMITTEE, "The report of the uranium processing plant criticality accident," Nuclear Safety Commission, STA, Japan (1999) (in Japanese)

- Social side effects
  - train, road, school, shops, etc.

Conclusions

γ dose rate observed in an other facility of JCO during the accident



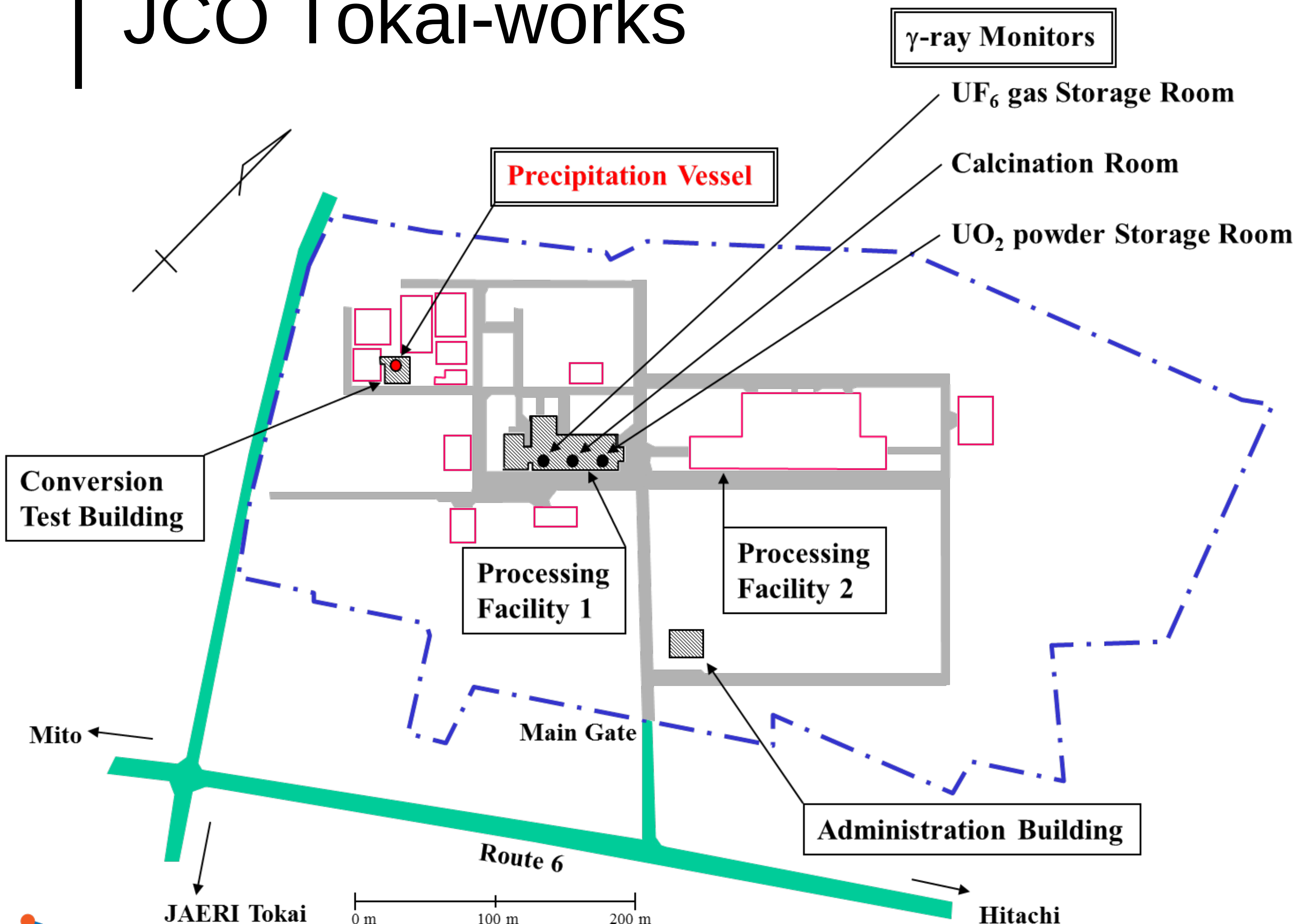
Tonoike, et al., "Power Profile Evaluation of the JCO Precipitation Vessel Based on the Record of the Gamma-ray Monitor," Nucl. Technol., **143**, 364 (2003)

- Assessment and Prognosis must be based on objective data, rich background information, and clear criteria for decision making in emergency.

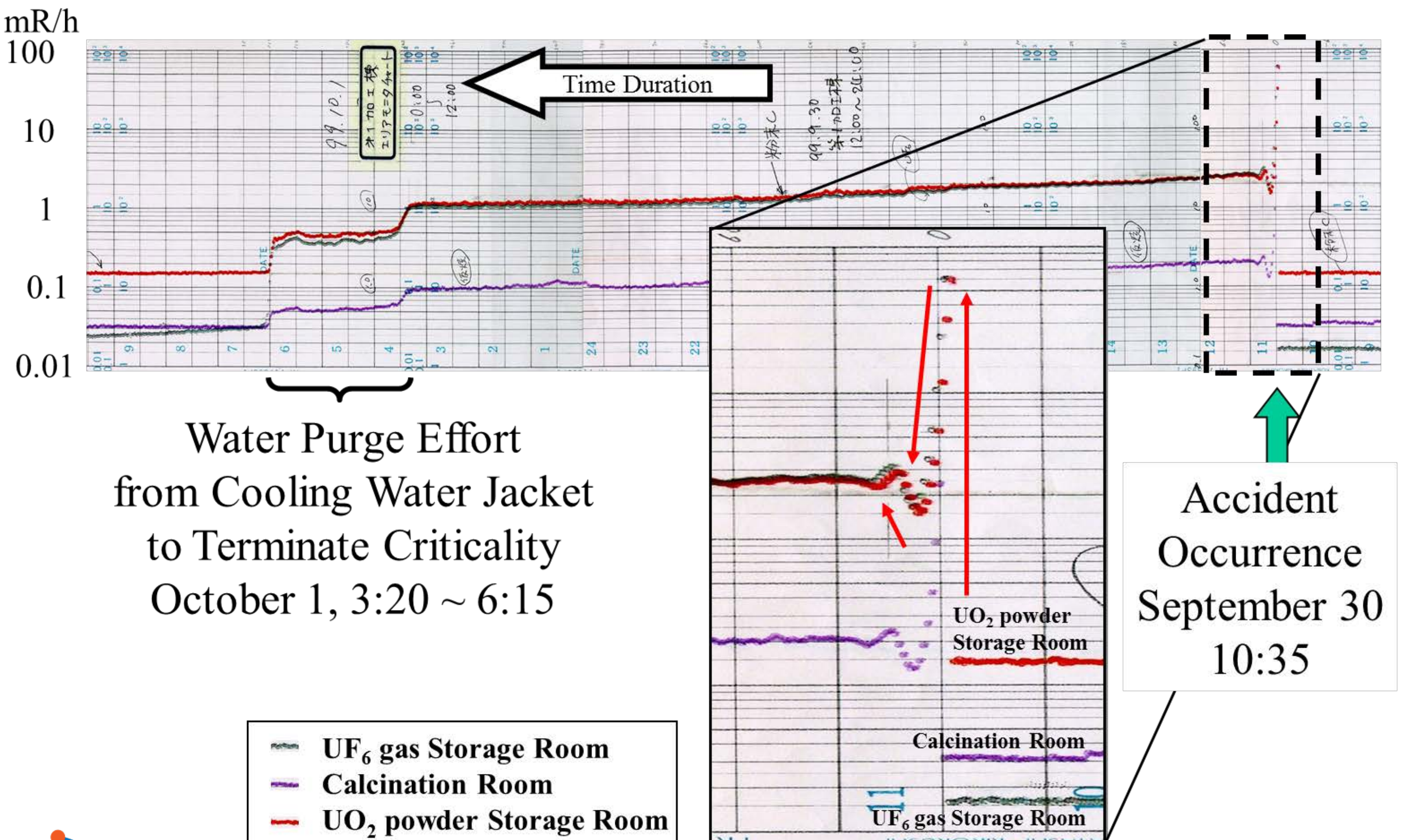
Appendix
JCO Criticality Accident Summary

Date & Time :	10:35, September 30, 1999
Duration of Criticality :	~19 and half hours
Location :	at the Precipitation Vessel in Conversion Test Building, JCO Tokai-works, Tokai-mura
Process of Accident :	Uranium refinement by reconversion
Cause of Accident :	Overfeed of uranium nitrate solution into a non-safe shape vessel beyond mass limit of criticality safety
Amount of Uranium :	16.6 kgU (18.8% U-235 enrichment)
Total Fission Number :	2.5×10^{18} fissions
Casualties :	2 workers dead who were manually feeding the uranium solution

Appendix
JCO Tokai-works



Appendix
Chart Record of γ-ray Monitor in PF1



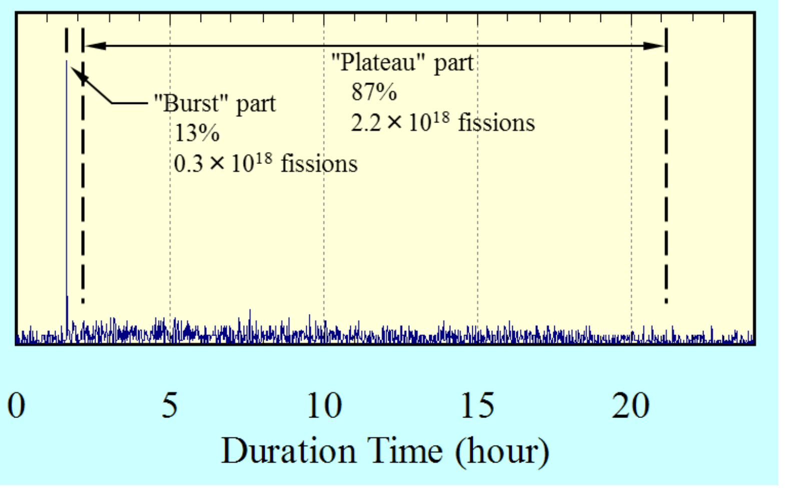
Appendix
"Burst" & "Plateau"

Total Fission Number : 2.5×10^{18} : Total fission number of the accident is derived from the FP density analysis of uranium solution sample taken from the precipitation vessel.

The First 12 sec. may be Missed : Maximum 12-second record of just after the accident occurrence may be missed in the chart and no quantitative information about the initial burst of the accident available. Therefore, overall shape of the chart record cannot be normalized using the total fission number : 2.5×10^{18}.

JAERI-Naka Neutron MP asserts "Burst : Plateau" = 0.3 : 2.2

A monitoring post of JAERI-Naka detected neutrons emitted from the precipitation vessel. The post sensed 13% of total neutron counts of the accident in the first 30 minutes which is called as "burst" part. The remaining is called as "plateau" part and shares 87% of fissions, e.g. 2.2×10^{18} fissions.



Appendix
Power Profile