# National Presentation - SERBIA

# DECOMMISSIONING OF THE RA RESEARCH REACTOR

Vladan Ljubenov, Nebojsa Dasic

VINČA Institute of Nuclear Sciences
Centre for Nuclear Research and Technologies NTI




R2D2P meeting, Manila, Philippines, 16-20 October 2006
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BELGRADE
Vinča Institute
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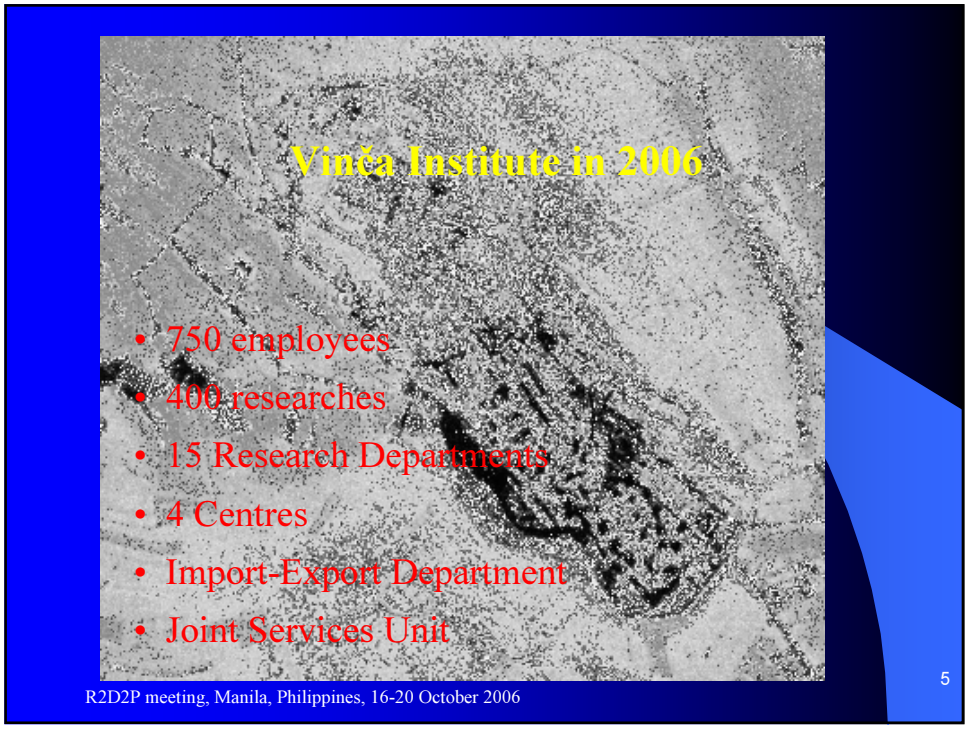
Vinča Institute in 2006
• 750 employees
• 400 researches
• 15 Research Departments
• 4 Centres
• Import-Export Department
• Joint Services Unit
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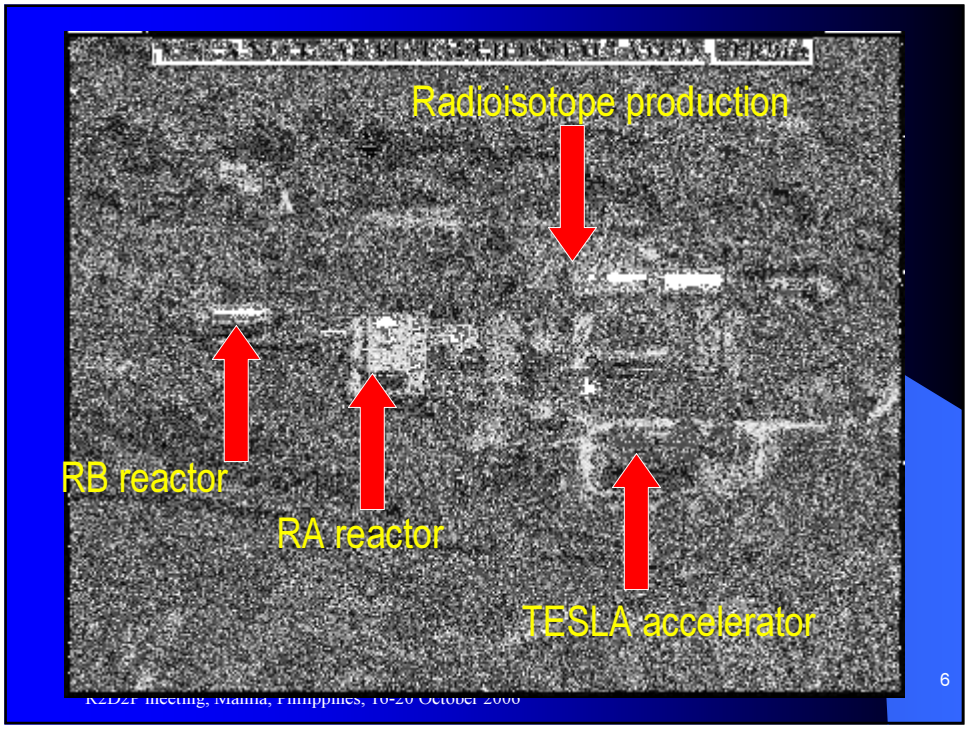
Radioisotope production
RB reactor
RA reactor
TESLA accelerator
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# VINČA INSTITUTE NUCLEAR DECOMMISSIONING PROGRAM

**Governmental decisions (July 2002 & February 2004)**

**Three Projects**:

- Spent Fuel Transport
- Decommissioning of RA Reactor
- Radioactive Waste Management at the Vinča site

Activities (Project no. 4):

- Nuclear and Radiation Safety
- Radiation Protection & Environmental Monitoring
- Administration Support

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# VIND Program Goals

- BASIC: to improve nuclear and radiation safety
  - Removal of highly irradiated, partially leaking - spent nuclear fuel from the RA reactor facility
  - Removal of all radioactive and contaminated materials and structures from the RA reactor facility
  - Construction of a storage and waste processing facility for the proper and safe storage and management of LL and ML radioactive waste (RAW) at the Vinča site

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RA reactor:
• owner – state, operator – Institute, regulator - RCNS
• heavy water - moderator and primary coolant
• tank type, graphite reflector
• 6.5 MW thermal power
• 1959 start of operation
• 1984 temporary shut down, license terminated, never restarted
• 2002 final shut down, to be decommissioned
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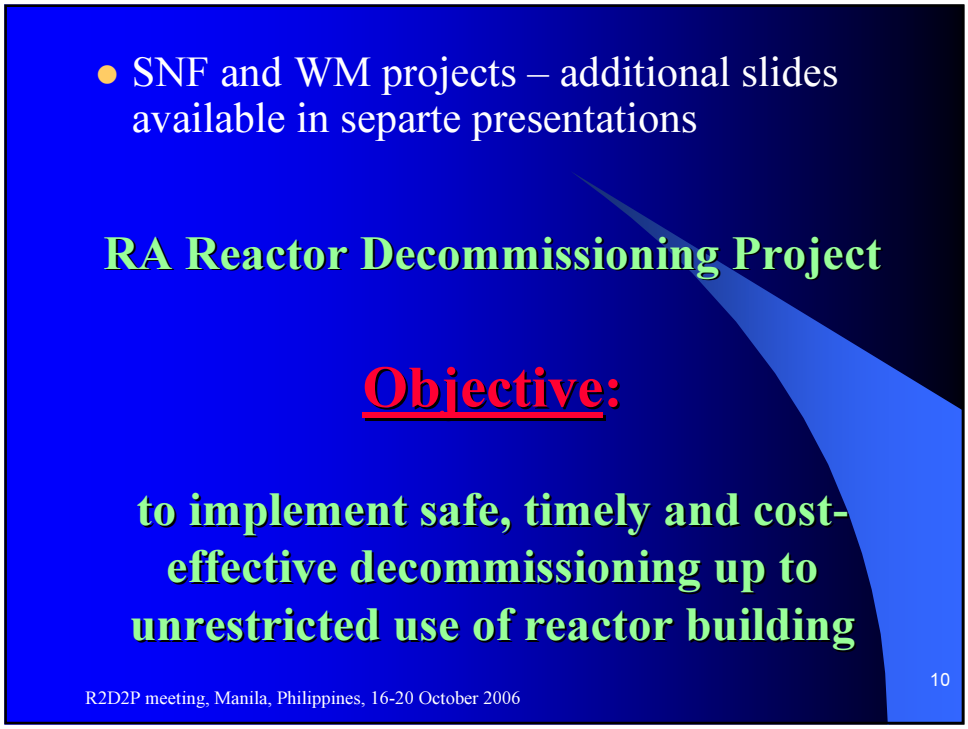
• SNF and WM projects – additional slides available in separte presentations
RA Reactor Decommissioning Project
Objective:
to implement safe, timely and cost-effective decommissioning up to unrestricted use of reactor building
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- Multiple facility site - RB, TESLA, radioisotope production
- No DP during design, construction, operation and extended shutdown
- Monitoring, surveillance and safeguarding on site
- No ideas, needs or requirements for the future use of the site
- Spent fuel still on site
- Existing waste storage facilities no adequate, no disposal
- Part of reactor building can be used for temporary storage of waste packages
- Decommissioning funds not fully available
- Improvement of the national decommissioning legislation is needed

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# Project goals:

**Short term goals** (before removal of the SNF):

- to prepare Decommissioning Plan for the RA reactor
- to complete radiological characterization in order to obtain all data needed for finaliyation of the dismantling procedures
- to remove from the building all the materials and equipment not needed during dismantling
- to perform regular maintenance of all systems needed in operation for safe and successful work

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# Project goals:

**Long term goals** (after removal of SNF):

- to perform decommissioning according to selected immediate dismantling strategy
- in that way to remove from the building all reactor structures, systems and components, all radioactive and hazard materials generated during the facility lifetime up to unrestricted use of the building
- to perform all the operations according to national regulations and international reccomendations in a safe (workers, public, environment) and cost effective manner
- to document all the activities according to regulatory and QMS requirements
- to obtain know-how in decommissioning which can be offered at market (Eastern Europe and developing countries)

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# Expected outputs:

- Aproved decommissioning plan
- Unrestricted use of the reactor building
- Safely stored radioactive waste material
- Further use of some components and materials from the reactor facility
- Know-how in planning, organization and implementation of decontamination, dismantling and other decommissioning activities

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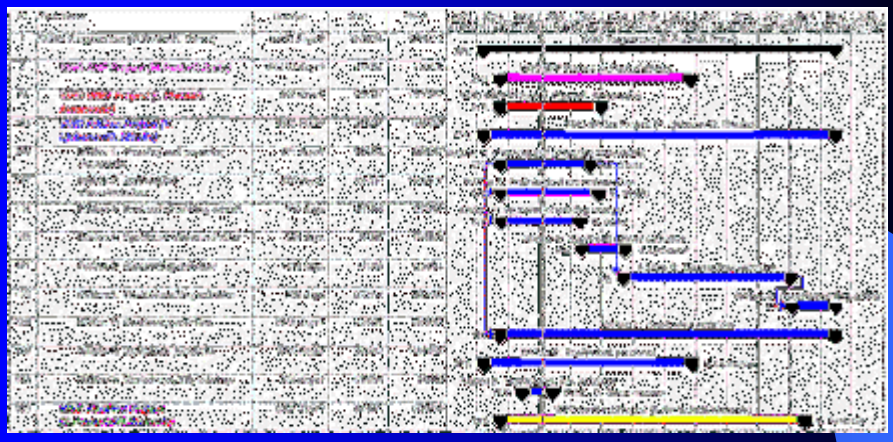
# Project duration:



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# Main Project Activities

- Radiological characterisation of the site
- Preparation of the decommissioning plan
- Removal of existing wastes from the operational phase
- Dismantling and demolition of the reactor components, systems and structures
- Decontamination of the surfaces and materials for reuse
- Final radiological site survey
- Preparing final project documentation and obtaining the approval for unrestricted use of the reactor building

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## Continuous Activities

- Surveillance and maintenance
- Decontamination
- Radiation protection
- Waste segregation and packaging
- Equipment purchase
- Quality assurance
- Record keeping
- Training
- Preparing procedures
- Preparing documents



## Project Approach, Support And Funding

- Program and team – established in Vinča Institute
  - –To keep available staff with knowledge about the facility
  - –To change the management of the facility – new organization Center NTI
  - –To restructure the organization around three main tasks
    - Surveillance and maintenance
    - Spent fuel removal
    - Decommissioning
- To use existing services in the Institute
  - –(RP&HP, WM, medical protection, fire protection, safeguards, export-import)

# Project Approach, Support And Funding

- Almost all dismantling activities will be performed inside the reactor building using mainly mechanical cutting and decontamination
- Ventilation will ensure underpressure in the reactor building
- Releases and effluents will be filtered and monitored
- Release and clearance criteria prescribed in the national regulations
- Government funding – regular since October 2004
- Donations from foreign institutions - expected
- Expert support from the IAEA - exists
- Equipment through the IAEA TCP - exists
- Close co-operation with experts and relevant companies from nuclear developed countries
- Experiences from other projects

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# IAEA TCP PROJECT SCG/4/004

**"Decommissioning of the RA Research Reactor in Vinča Institute"**
**(2003-2007, to be extended until 2012)**

**contracts for services, contracts for the equipment purchase, expert missions, trainings and fellowships**

- **Planning, MS Project training, CE, Characterization**
- **Sampling equipment (cutting and drilling tools)**
- **Survey instrumentation**
- **Portable HEPA ventillation system**
- **Vacuum blaster, vacuum cleaner**
- **ASTRA, HWRR, GTRR, SAPHIR, DIORIT**
- **Participation in the IAEA technical meetings (DeSa Project)**

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## Activities in 2003

- Assembly the necessary records at a central location
- Design of the documentation data base
- Review reactor documentation, labeling and recording
- Entering the data in the data base
- Identification of the decommissioning team
- Defining the roles and responsibilities
- Preparation of the outline of the decommissioning plan
- Comparison of the documentation with existing facility layout
- Evaluation of the strategy options
- Selection of a decommissioning strategy - ID
- Development of the Characterization Plan for the facility
- Preparation of basic chapters of the decommissioning plan

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## Decommissioning Strategy

Three main options analyzed:

- Immediate Dismantling – selected as optimal
- Deferred Dismantling (or Safe Enclosure)
- Entombment - opposite to the strategic ideas of the Vinča management and Serbian Government

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# Strategy Selection

Based on:

- Governmental policy, laws and regulations – not adequate
- Safety assessment of the hazards
- Availability of waste management systems – WM project
- Availability of funding - partial
- Physical status of the facility and residual activity
- Availability of experienced staff - ageing
- Plans for the future use of facility or site – do not exist
- Social and economic impact
- Availability of the technologies needed
- Public opinion and involvement

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3 500 documents in data base

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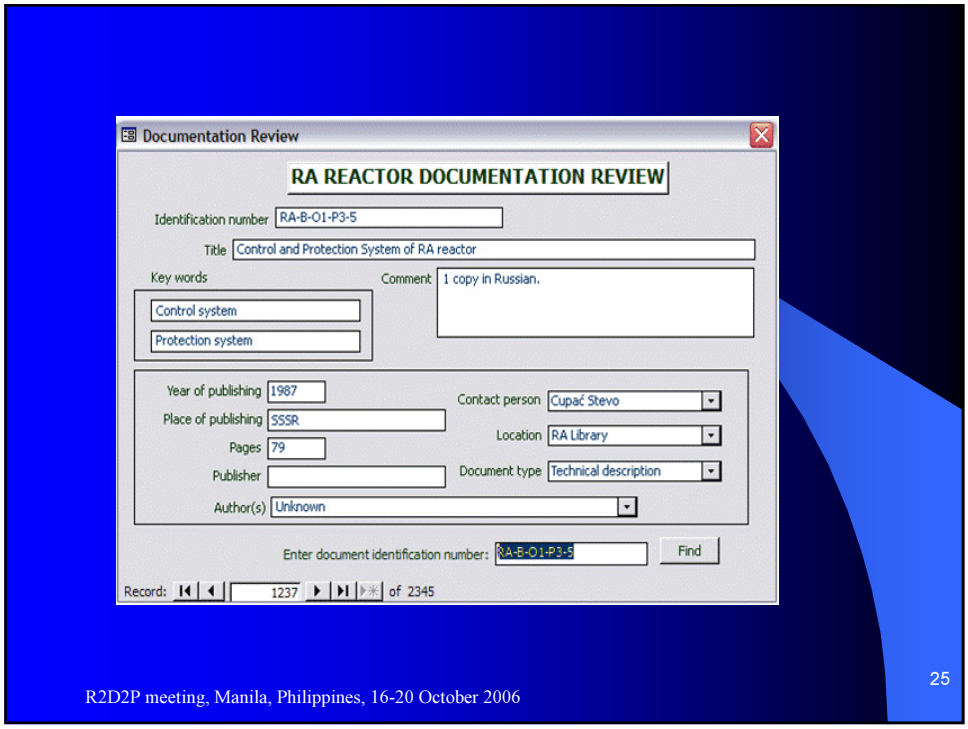
Documentation Review
RA REACTOR DOCUMENTATION REVIEW
Identification number RA-B-O1-P3-5
Title Control and Protection System of RA reactor
Key words
Control system
Protection system
Comment 1 copy in Russian.
Year of publishing 1987
Place of publishing SSSR
Pages 79
Publisher
Author(s) Unknown
Contact person Cupać Stevo
Location RA Library
Document type Technical description
Enter document identification number: RA-B-O1-P3-5
Find
Record: 1237 of 2345
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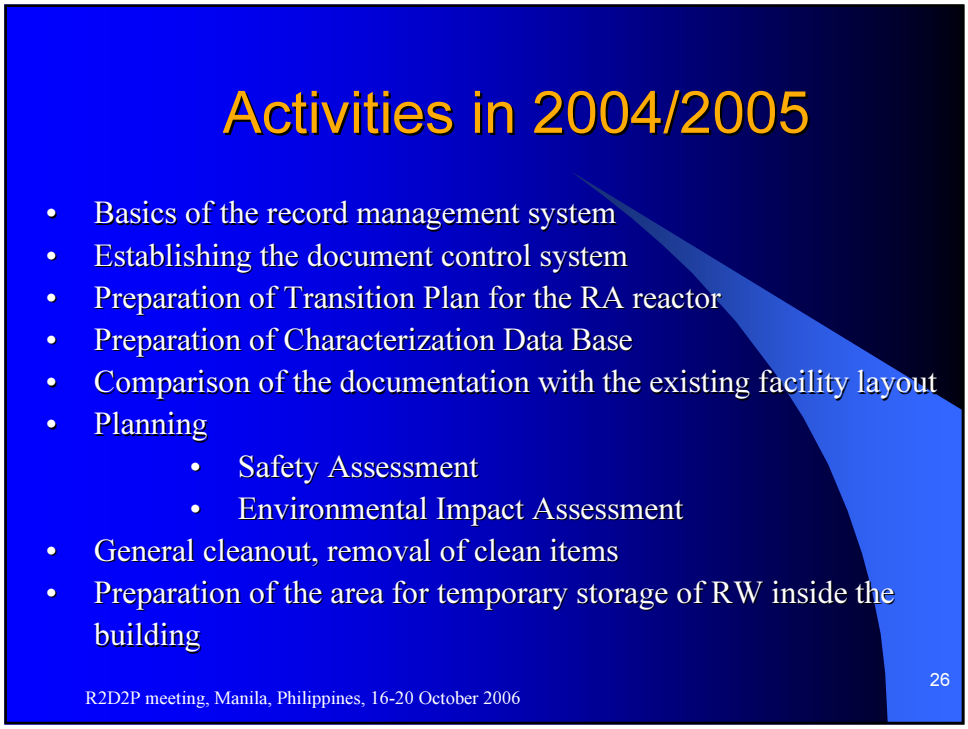
Activities in 2004/2005
Basics of the record management system
Establishing the document control system
Preparation of Transition Plan for the RA reactor
Preparation of Characterization Data Base
Comparison of the documentation with the existing facility layout
Planning
Safety Assessment
Environmental Impact Assessment
General cleanout, removal of clean items
Preparation of the area for temporary storage of RW inside the building
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# Activities in 2004/2005

- Start of radiological characterization
  - Review of the historical data
  - Development of the calculation procedures and models
  - Drawings of the reactor rooms
  - Preparation of sampling and measurement procedures
- Preparation and establishment of the national program
- Internal training
  - Radiation protection
  - Industrial safety and first aid
  - Characterization survey

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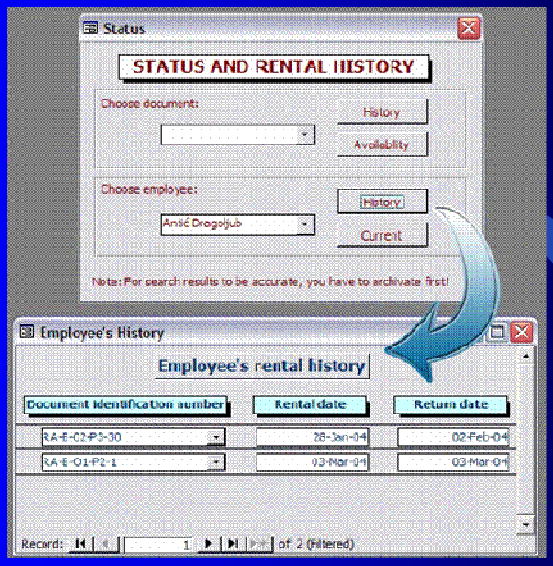


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# Activities in progress

1. Preparation of the Decommissioning Plan and supporting documents
2. Radiological characterization
3. Removal of materials and equipment from the building
4. Maintenance of the reactor systems and building

Other projects

- improvement of the RAW storage and WM treatment facilities on site
- Preparatory activities for SNF repackaging and transport to Russia



# Planning

Three levels of documents:

- National legislative/regulations (Law on RP&NS)
- VINCA Institute regulations/plans (RP, EP, QA, PSS, WMS)
- Facility documents/regulations/plans (SAR 1986, Operation rulkes and regulations 1989)

- Existing regulatory framework not appropriate, new law, Agency
- Decommissioning Plan to follow all the requirements of national legislative, in accordance with IAEA SRS 45
- VIND Safety Case approach

## Decommissioning Plan: 15 chapters

- Introduction
- Facility Description
- Project Management
- Decommissioning Strategy
- Decommissioning Activities
- Surveallance and Maintenance
- Safety Assessment
- Environmental Impact Assessment
- Waste Management
- Health and Safety Plan
- Cost Estimate and Funding Mechanisms
- Quality Assurance Program
- Emergency Planning
- Physical Security and Safeguards
- Final Radiological Survey

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## Preparing the documents

- Strategy Options Study
- Radiological Characterization Plan
- Transition Plan
- Characterization Report – first phase
- Number of analyses and studies performed to support preparation of some documents

- Other supporting activities during the transition period:
  - Collecting, review and organization of the documentation and records
  - Comparison of the documentation with the existing facility layout
  - Development of the software tools for the efficient data organization, archiving, search and for the generation of the reports

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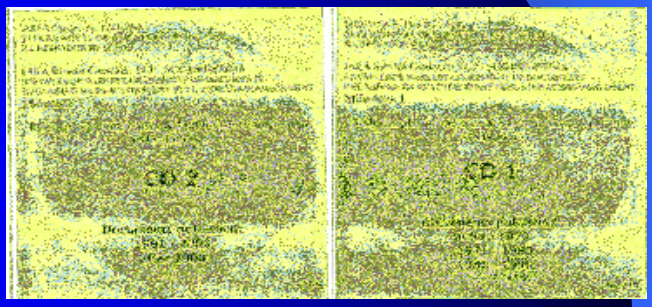
The International Nuclear Information System
INIS 35th Anniversary 1970–2005
The World's Leading Source of Nuclear Information Since 1970
www.iaea.org/inis

850 documents already in INIS data base



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# Radiological Characterization

- Review of the operational history and the records about events with the radiological consequences, comparison with new results of the burnup analyses and measurements
- Development of the computing and simulation models, numerical determination of the neutron induced activity in the active zone and surrounding structures (3D models, MNCP-ORIGIN and KENO-ORIGEN calculation procedures, original approach for zones arround the core – coupling neutron flux and adjoint flux)
- Preparation and implementation of the Sampling and Measurement Plan
  - In situ measurements
  - Laboratory measurements of the samples
    - smears, scrapings, bulk samples, liquid samples, environmental samples
- Analyses of the results and the preparation of the Characterization Report

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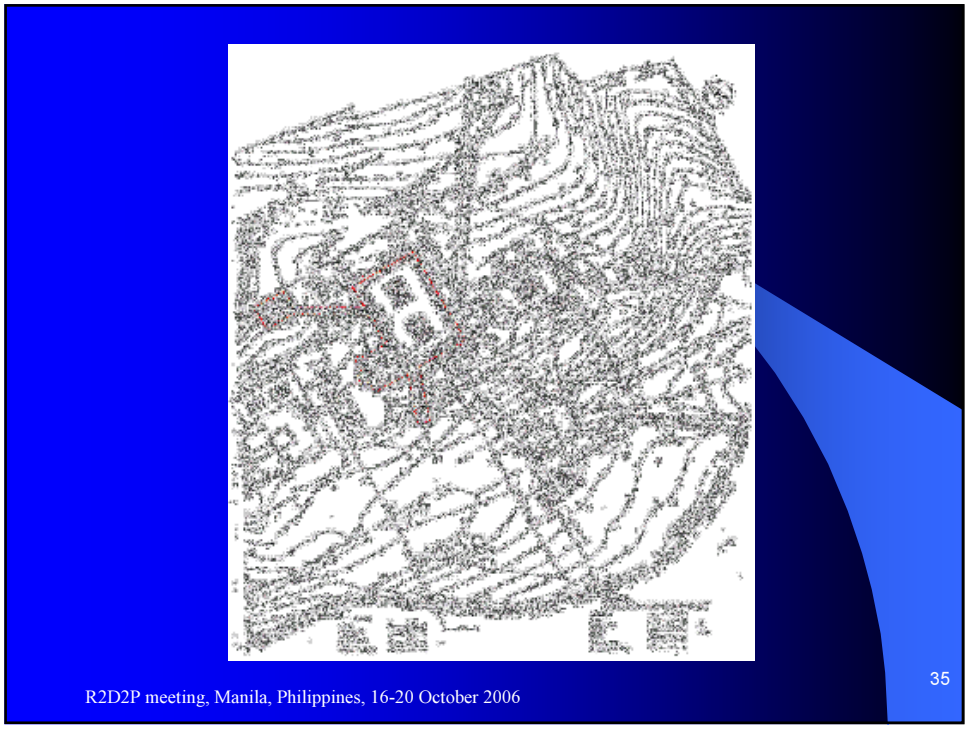

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## Fuel burnup measurements

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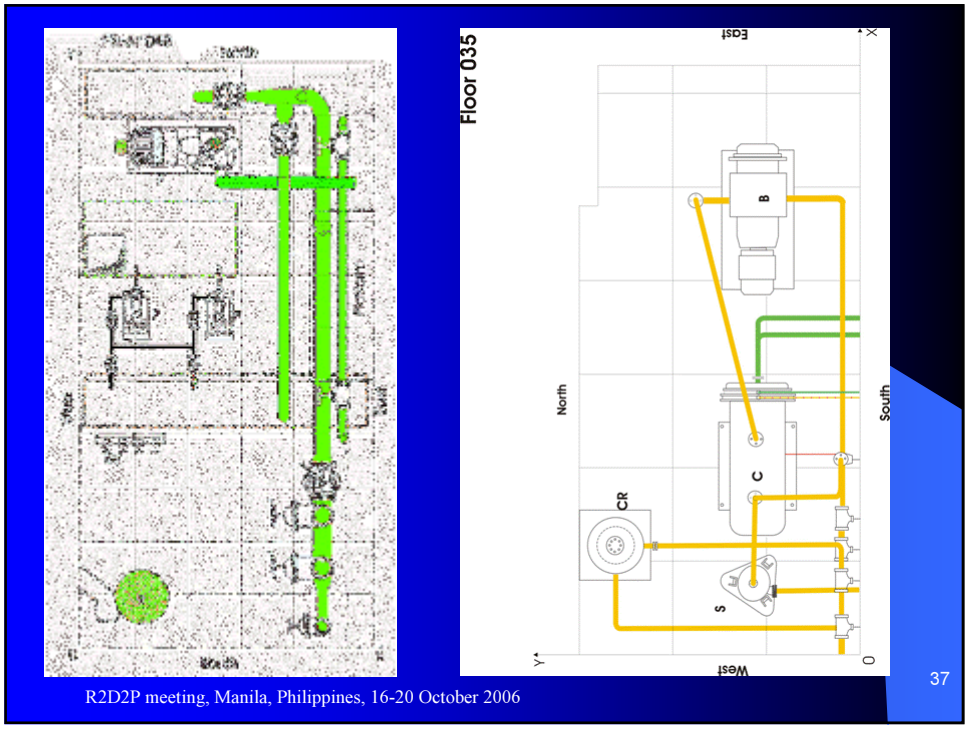
Floor 035
East
North
South
West
B
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CR
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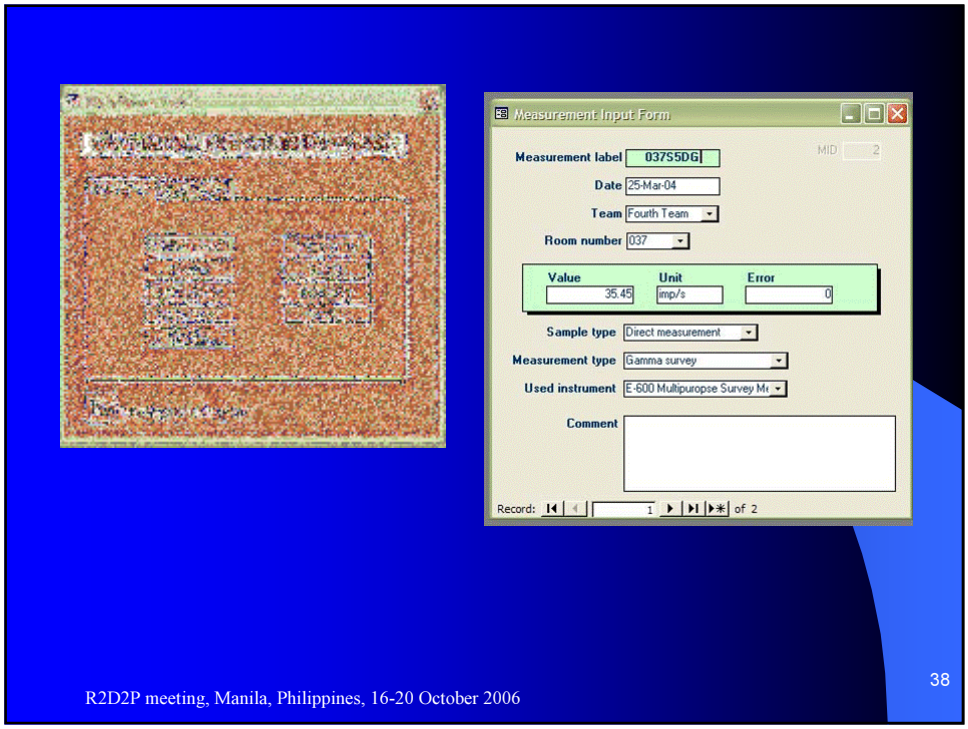
Measurement Input Form
Measurement label
037S5DG
Date
25-Mar-04
Team
Fourth Team
Room number
037
Value
Unit
Error
35.45
imp/s
0
Sample type
Direct measurement
Measurement type
Gamma survey
Used instrument
E-600 Multipurpose Survey Me
Comment
Record:
of 2
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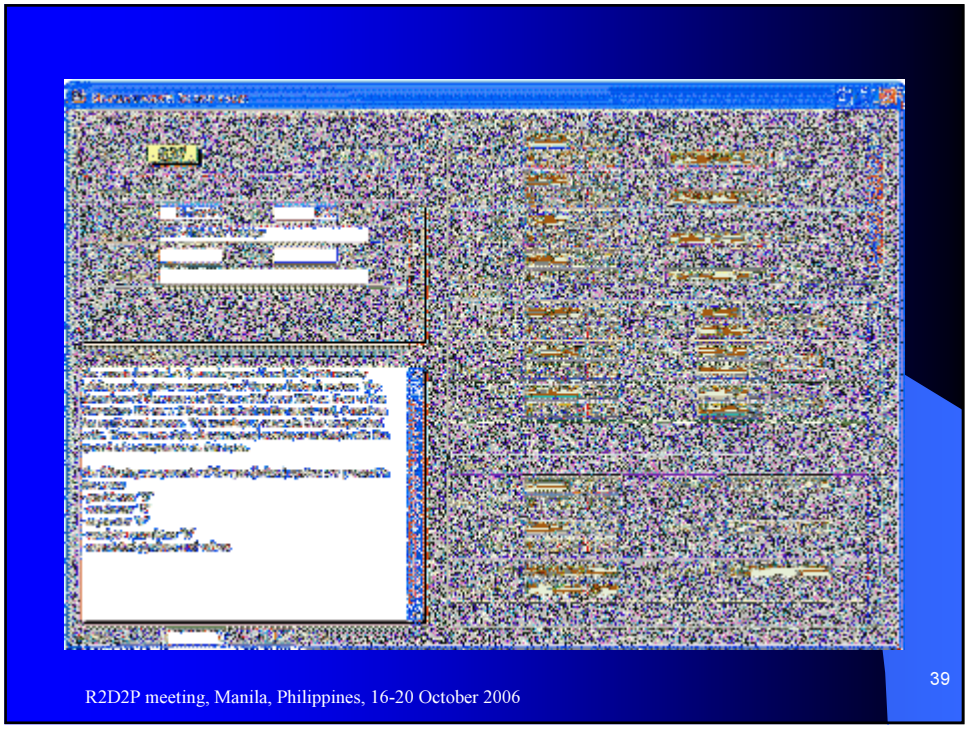

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# Survey Progress

- Reactor building
  - Underground rooms (reactor external systems)
  - Ground level (without reactor and SNF rooms)
  - First floor
  - Attic
- Surrounding area
- Ventilation centre

# Equipment and waste removal

- Goal: to clean the working area and to reduce radiation, industrial and other risks
- Specail attention to the radioactive materials, chemical hazards, flammable materials, liquids

- Inventory of the equipment and materials for the removal
- Preparation of the areas for the temporary storage
- Radiological characterization – separation of the clean and contaminated items
- Clean – recycling, reuse, conventional waste
- Contaminated – decontamination or radioactive waste
- Activated – cutting, dismantling, RAW

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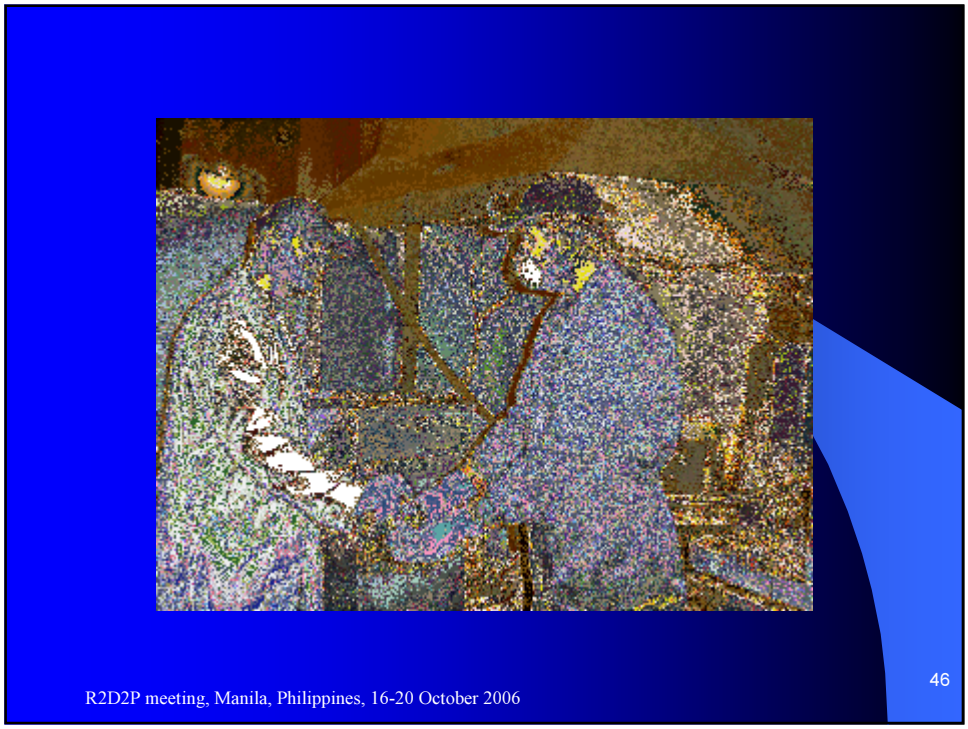
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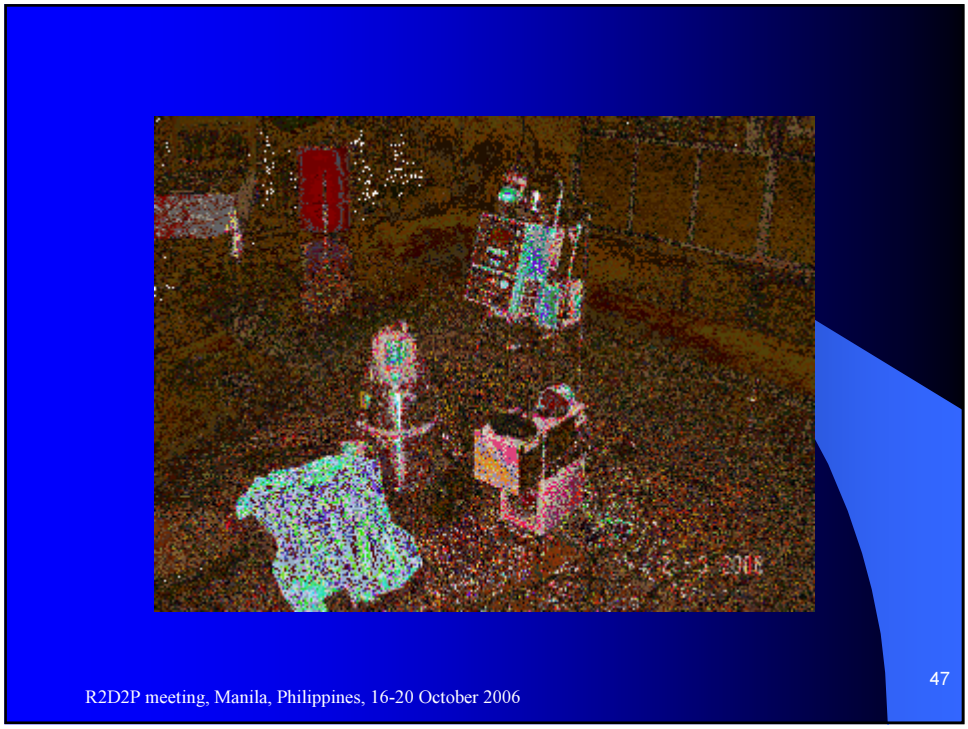
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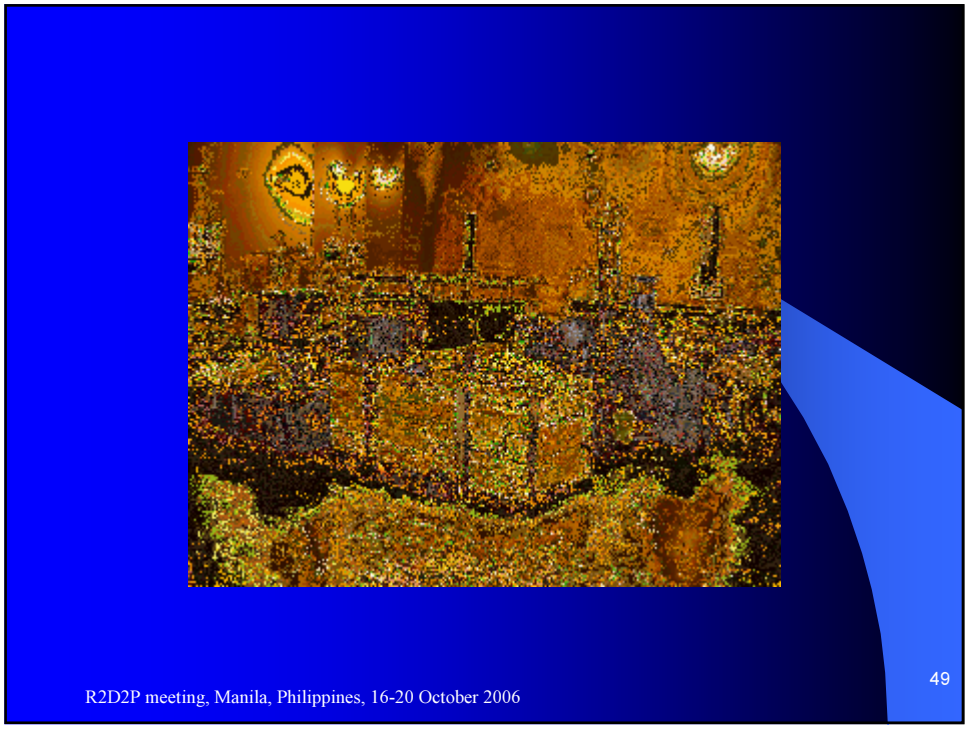
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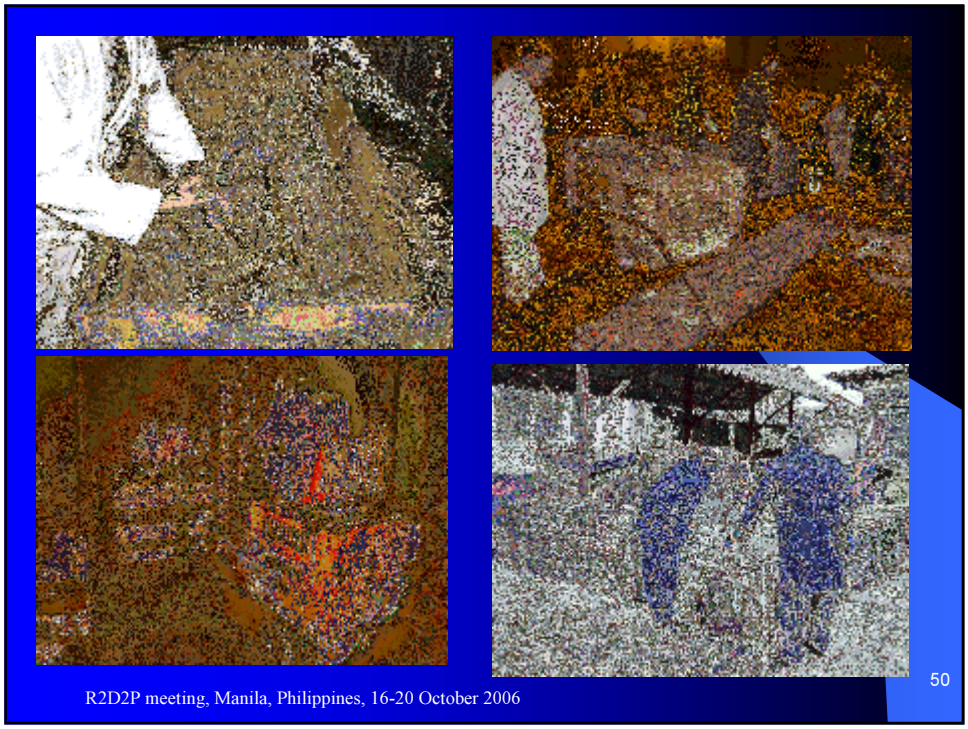
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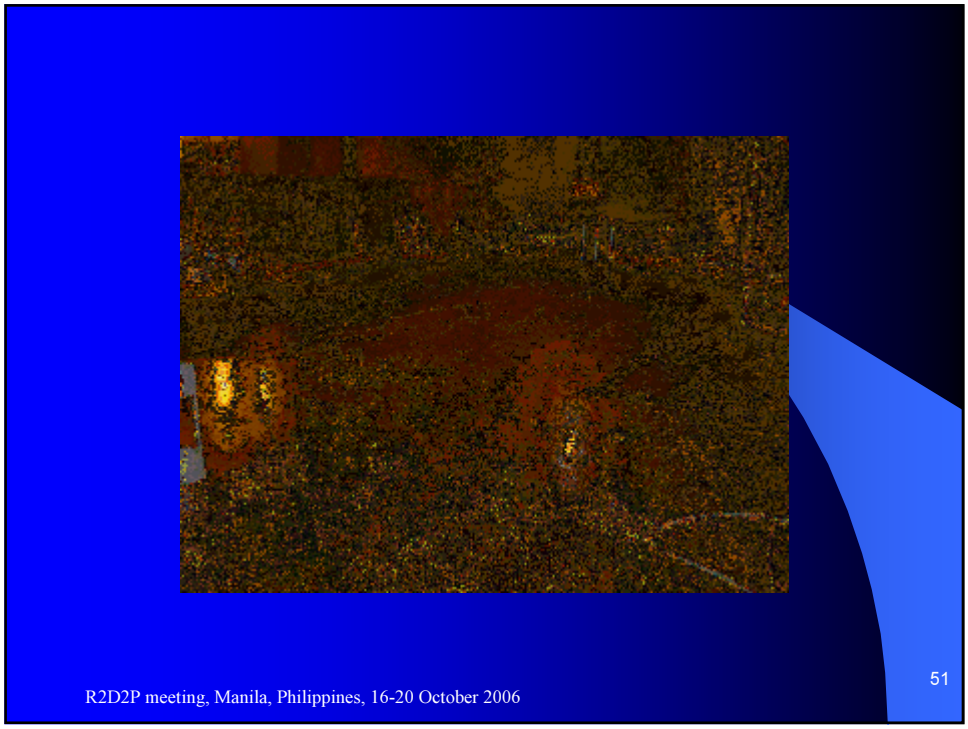
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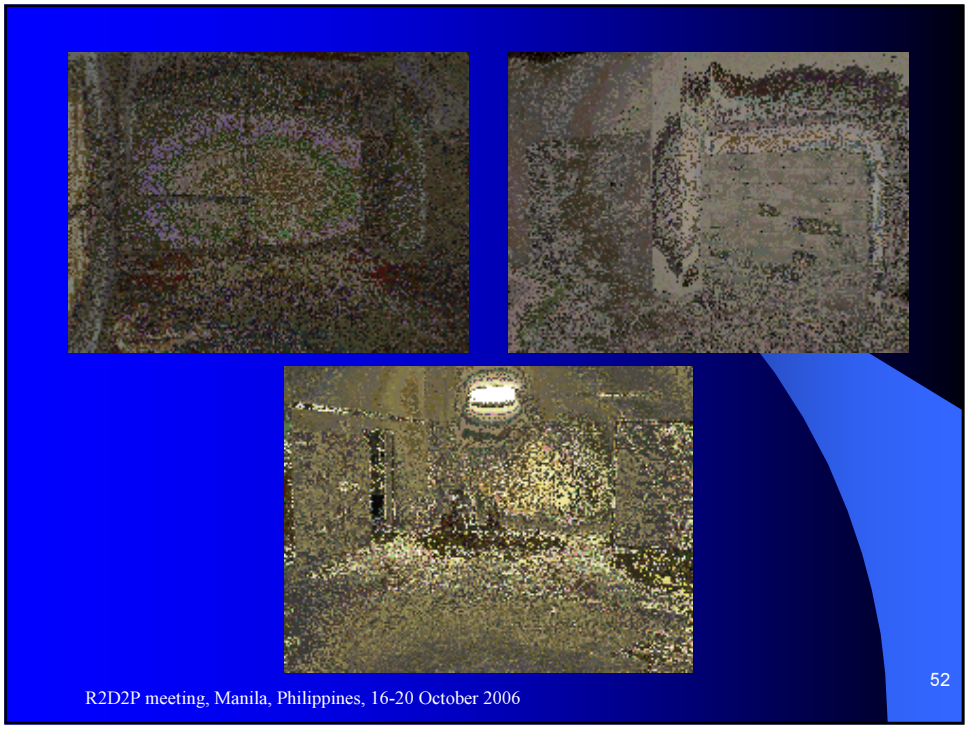
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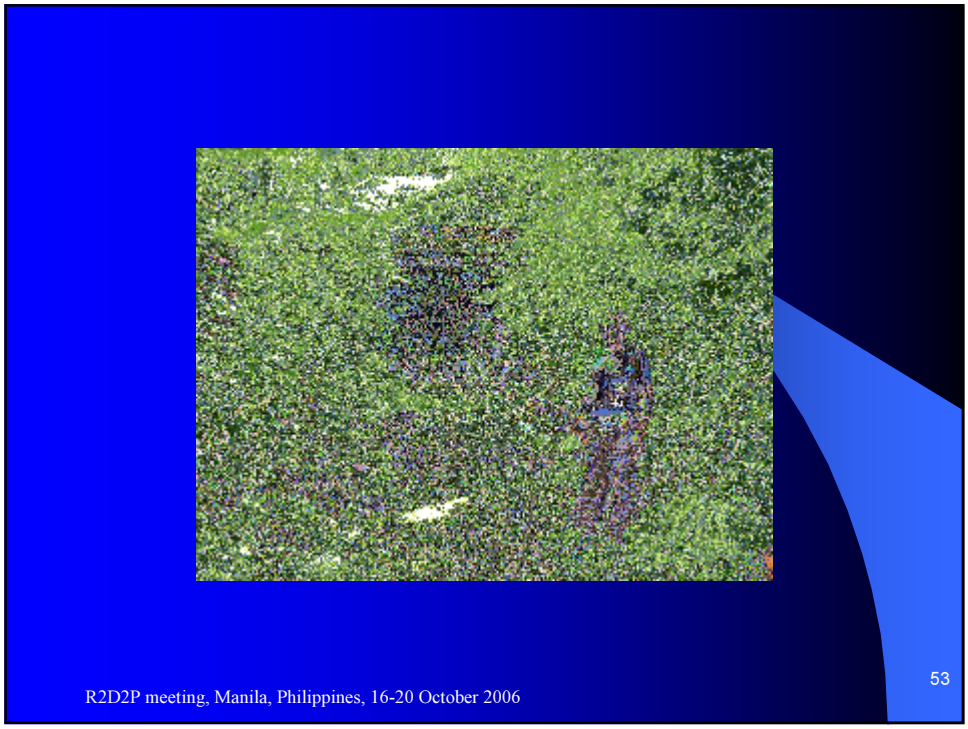
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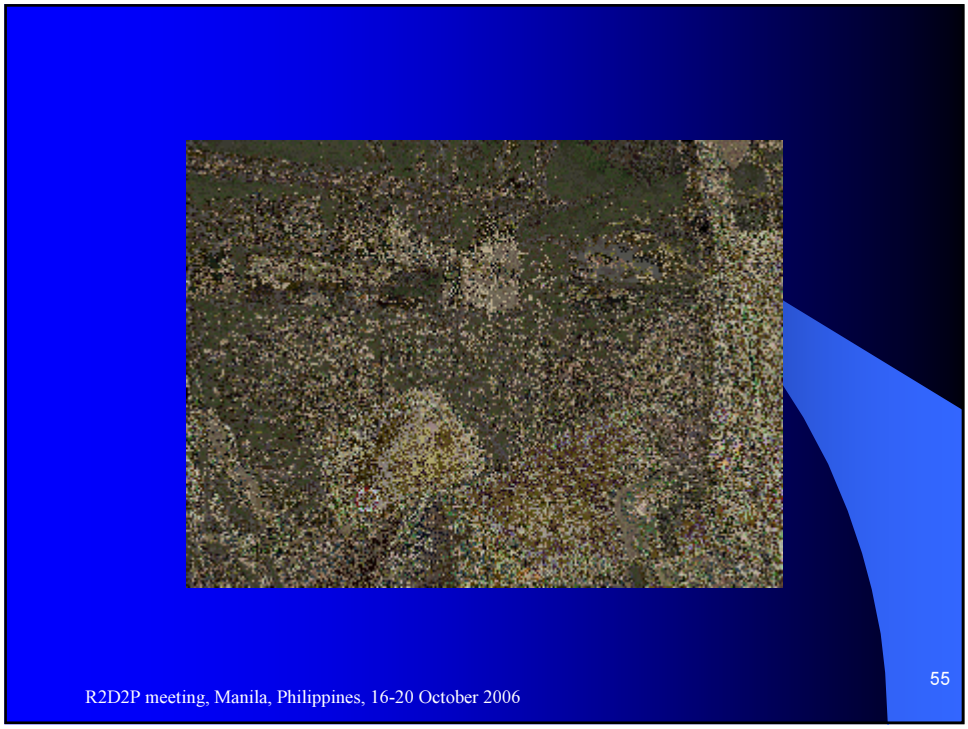
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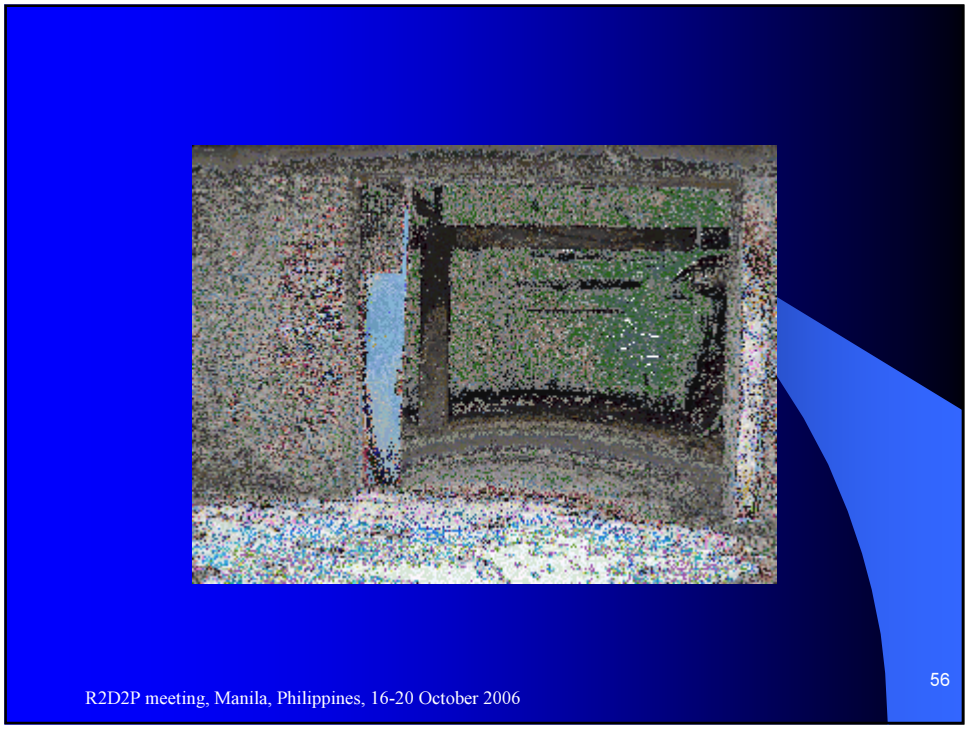
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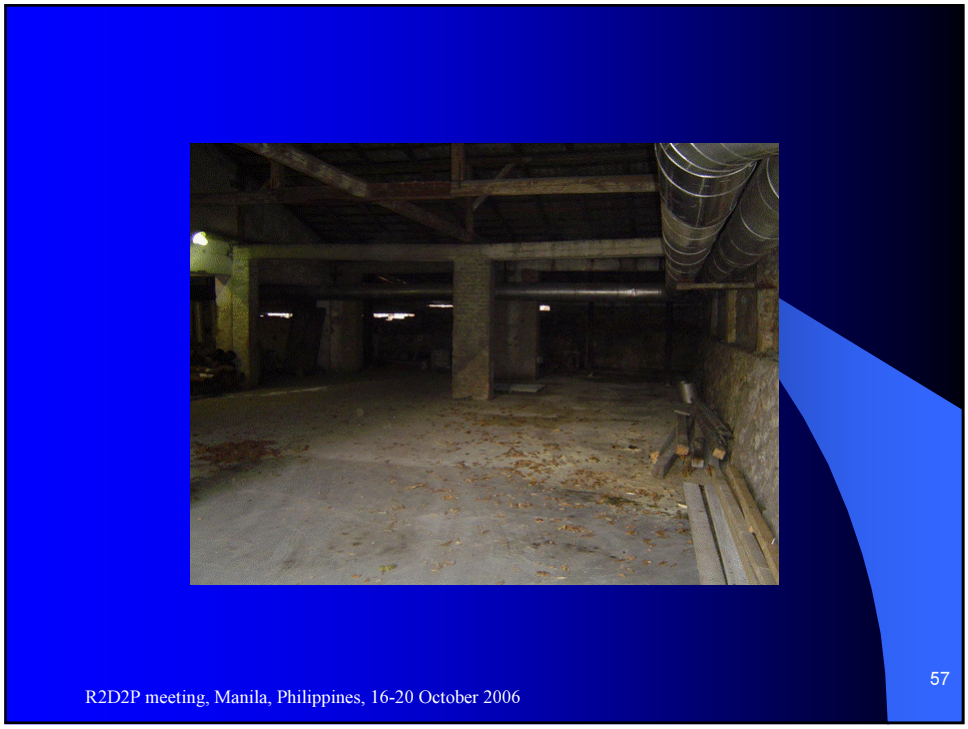


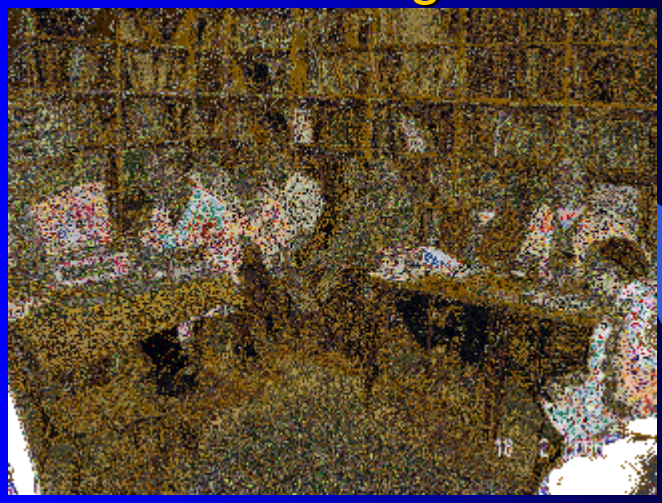


# Reactor maintenance

Mechanical, electrical, instrumentation sections

- SNF pools
- Safeguards inspections
- Ventilation
- Ducting, filtration, monitoring
- Stationery radiation monitoring
- Heating system
- Water supply
- Power supply
- Transport devices
- Canalization, liquid waste pumps
- Fire protection

## Training



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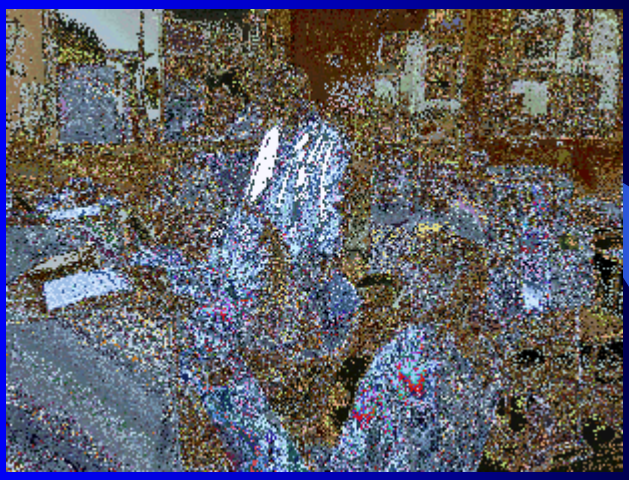
## International Colaboration



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# First dismantling operation

- Removal of the carbon-steel construction from the SNF pool – end of October 2006
- Two stage operation
  - Underwater contact arc cutting of contaminated structure, remote controlled
  - Plasma arc cutting in air bellow protective tent for waste size reduction
- Portable ventilation units with HEPA filters
- Full respiratory protection
- Continuous air sampling
- RCNS approval needed
- SAR prepared, 17 procedures (11 operation, 3 WM, 2 RP, 1 fire protection)
- Russian equipment for cutting mounted and tested, training completed
- Ventilation upgrade, additional shielding for dry pool, new exit contamination monitor
- Institute RP manual and EP updated
- New WMS and WAC approved by VNRSC

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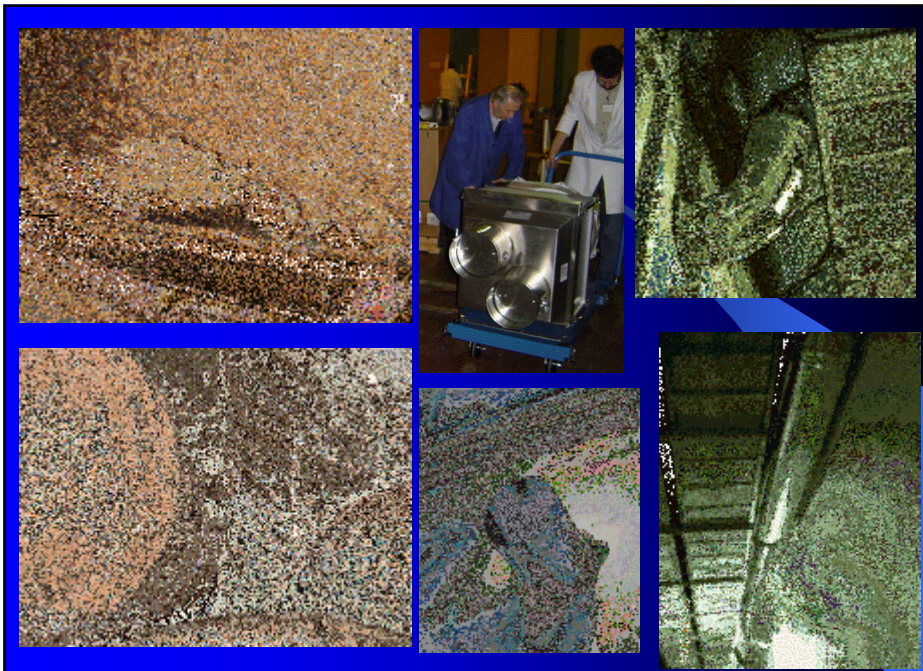

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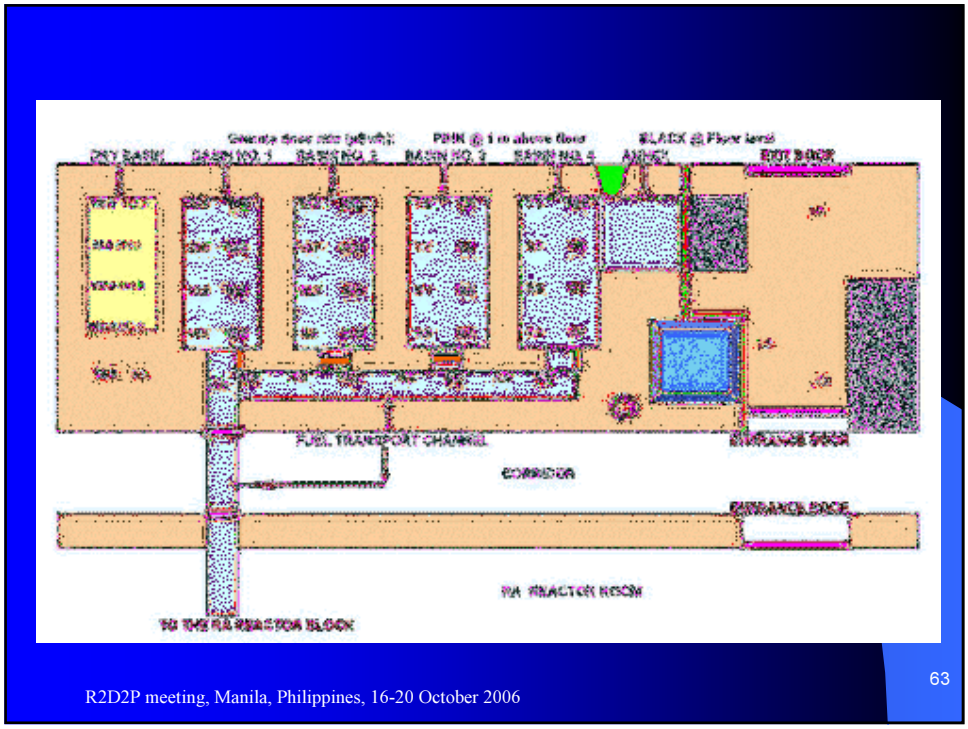


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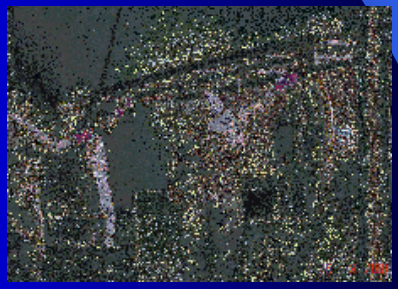

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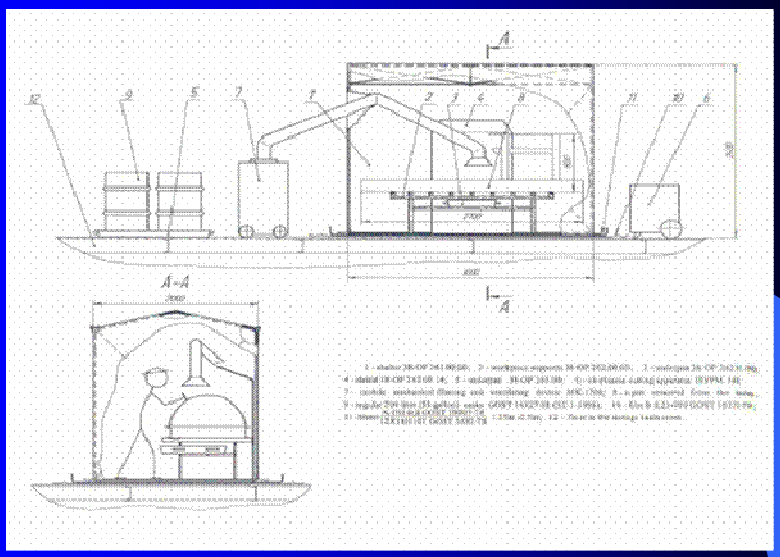



# Conclusions

- Goal – unrestricted use of the building
- Strategy – immediate dismantling
- SNF and some aspects of the WM covered by other VIND projects
- DP based on IAEA guidance, RA SAR good basis, lack of some upper level documents
- SNF, DP and CHAR in progress
- IAEA support, international colaboration


Thank you for your attention
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http://ntrp.vin.bg.ac.yu
R2D2P meeting, Manila, Philippines, 16-20 October 2006
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