

**SAFEX INTERNATIONAL XV CONGRESS
GENEVA MAY 25. - MAY 28. 2005**

**DECONTAMINATION OF THE GULLAUG PLANT –
NORWAY**

ARNE RAFDAL

M. Sc. Mining Engineer

Security Manager Dyno Nobel Europe, Middle East & Africa.

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Groundbreaking Performance

My background.

- **M. Sc. Mining Engineer. (1976)**
- **Mine Manager in the underground Coal Mines at Spitsbergen (Svalbard, 79° North).**
- **Mine Manager in 2 different underground mines in Norway.**
- **Head of Section for Explosives, National Authorities.**
- **From 1990. Dyno Nobel ASA.**
 - **Chief Engineer Technical service, blasting technique.**
 - **Chief Engineer operating Bulk Explosives.**
 - **Plant Director Gullaug Plant**
 - **Project Manager Decommissioning Gullaug Plant.**
 - **Security Manager Dyno Nobel Europe, Middle East & Africa.**



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History Gullaug Plant.

- **The production at Gullaug Plant started in 1917.**
- **From 1954 to 2001 – there has been:**
 - **3 accidents with the total of 7 employes killed.**
 - **3 accidents with he total of 4 employees injured.**
- **In January 2001, we had an explosion in the Nitration House. No employees where injured, but the building completely destroyd.**
- **Number of employees at Gullaug Plant 2001 ; 120.**
- **Production; cartridged explosives (NG), cartidged emulsoin, ANFO, detonating cord and Ballistite.**

Explosion in nitration house, Gullaug, 23.01.01

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15.01.01.....



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6

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Explosion in nitration house

23.01.10 at 10:08:15

- Approximately 100 kg nitroglycol “exploded”
- No persons was injured
- Complete destroy of equipment and building
- Large amount of nitric gases was relieved
- Measured 0,14 on Richters scale

23.01.01 at 10:10.....



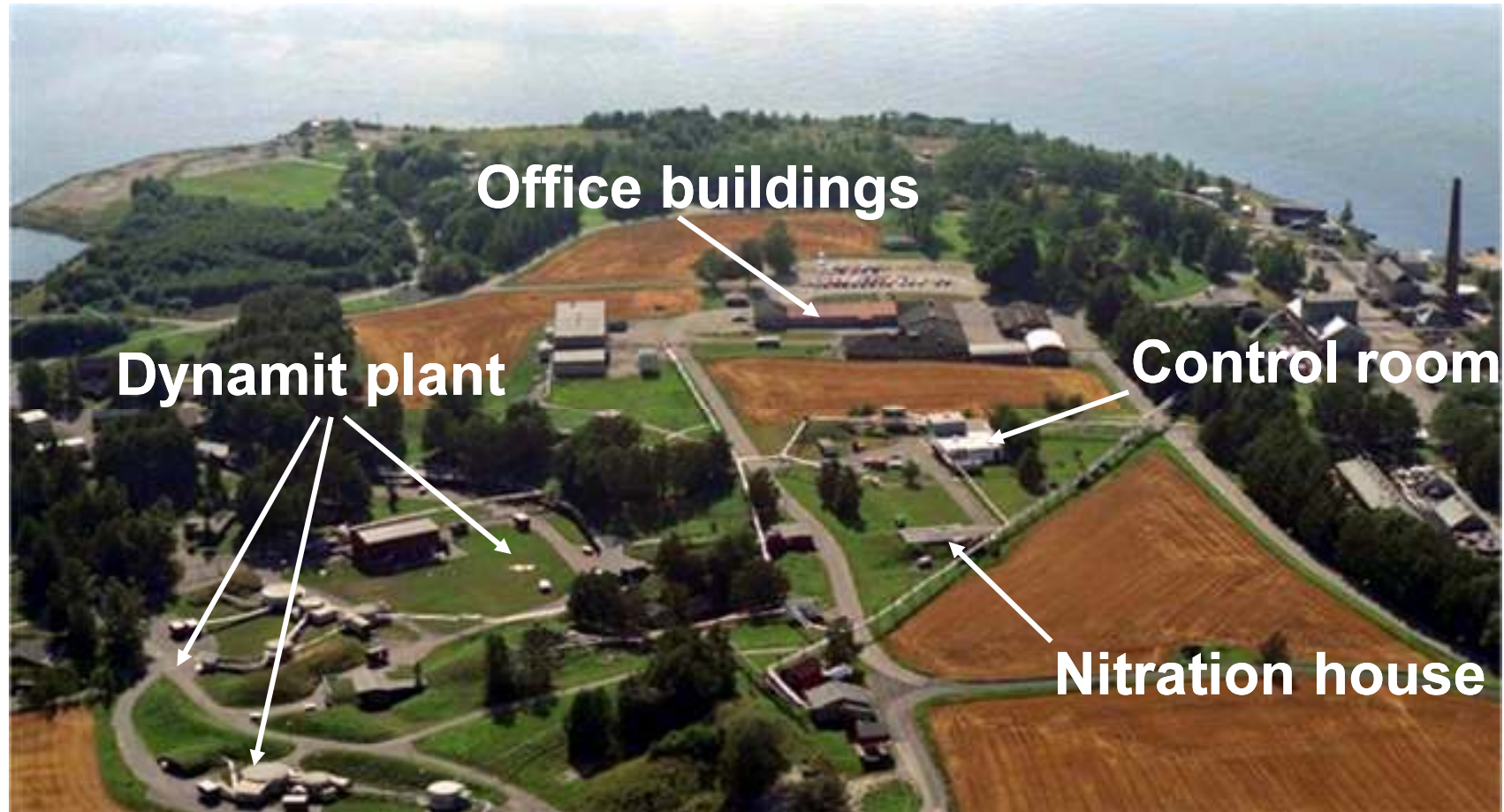
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23.01.01 at 12:00.....



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An overview over Gullaug



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Heavy damage to building



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Floors and roof thrown away



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No process equipment left



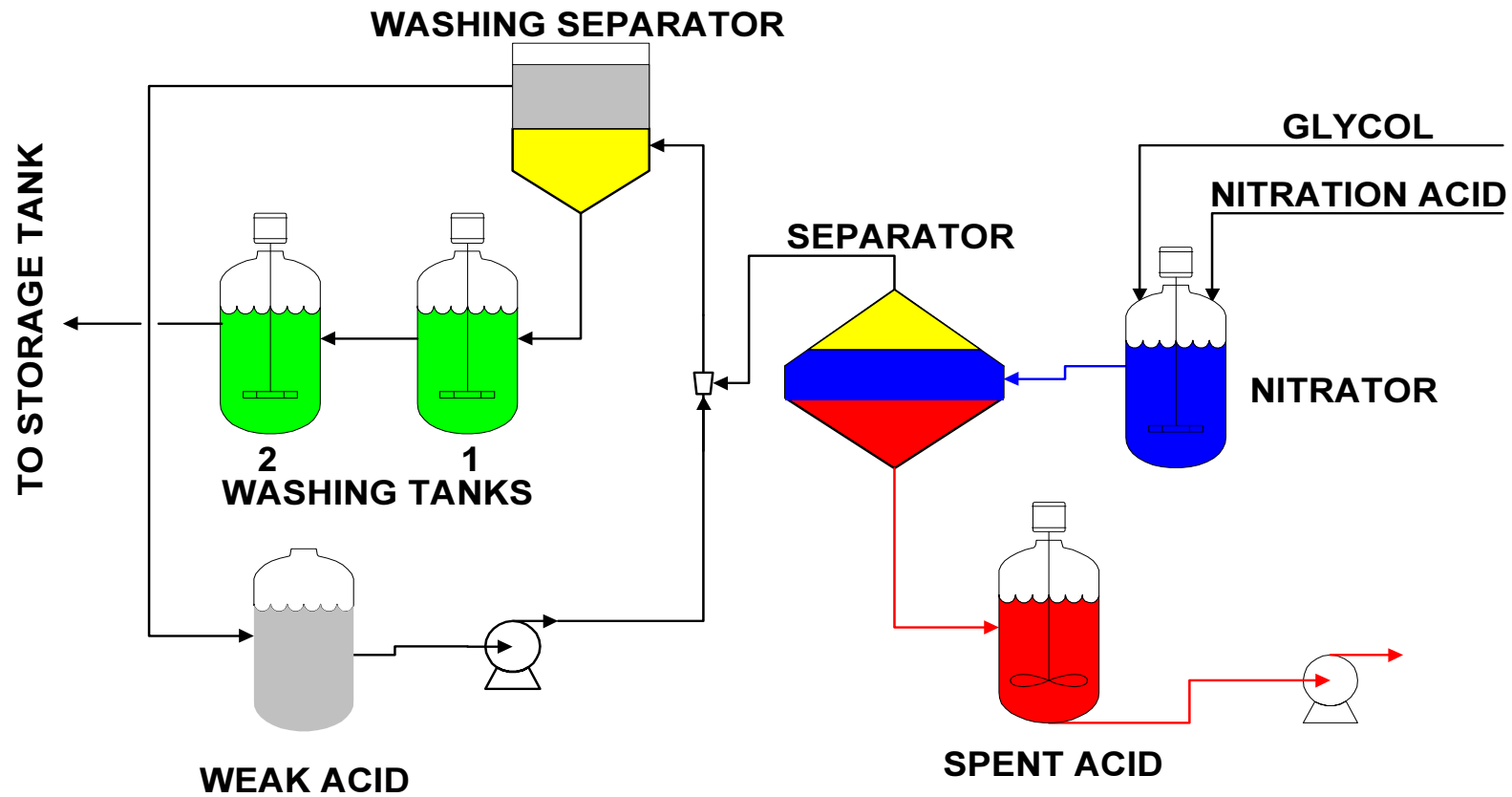
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13

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Schematic flow diagram



Organizing the Decommissioning work

- It was established a project in 2001 running to 2006.
- The ANFO plant would still be in production.
- Project Manager Arne Rafdal.
- We kept 23 employees with average age 57 year and long experience from production- and maintenance work.
- They got a pension contract reaching 62 year.
- The manning to day is 8, and by the end of the year it will be 3 employees.

Organizing the work.

- **I established a reference group with members from:**
 - **The authorities for the explosive industry in Norway**
 - **Other explosives companies with experience from decommissioning work. (3 different companies).**
- **Contract with an environmental consulting company (MiløBistand) in Norway.**
- **Contract with a company (NOAH) for waste disposal.**
- **Challenges: Environmental Authorities.**

Phase 1.

- **Working out a program for mapping and sampling of the plant area aprox 150 acres, regarding m³ earth contaminated with:**
 - **NG.**
 - **DNT/TNT.**
 - **PCB/PAH.**
 - **Other environmental contamination.**
 - **Sampling and taking video the seashore.**
 - **Taking video of the process waste water system.**

Phase 1. Mapping

- **For the Gullaug Plant, we divided the hole area in a grid system, starting with 100x100m in the agricultural area which was a part of the safety zone for the plant.**
- **The intention was to take/establish reference samples for the area.**
- **The plant area we divided in a grid system of 10 x10 meter.**

Phase 1. Results of mapping.

- **Aprox 12.000 m³ earth contaminated with TNT/DNT.**
- **Aprox 2.000 m³ earth contaminated with PCB/PAH.**
- **Minor contamination with NG.**
- **Minor contamination with other environmental poison.**
- **Stripping down a 500m steam pipe isulated with asbestos.**
- **Aprox 100 buildings (most concrete and brick) to be demolished, incl stripping down the production equipment.**

Phase 1. Sampling.

- **To take samples we used both earth drilling and excavation, using a minor excavator.**
- **All samples were first analysed on NG before they were sent to an external laboratory.**
- **Before this work started, we carried out interviews with a number of former employees regarding possible environmental (incl. explosive) contamination.**

Phase 1. Sampeling. Surprises.

- **Excavation/sampeling in the area for burning waste from the production. Interviews told us that nothing was burried down there.**
- **1 meter under the surfase we hitted cartridged emulsion explosives. When we stripped the area, we had a total of 1 tonn cartridged emulsion explosivs!!**
- **Tests showed that the cartridged emulsion still was cap sensitiv.**
- **After some time ”momory cleared up”. This was burried down aprox 25 years ago.**



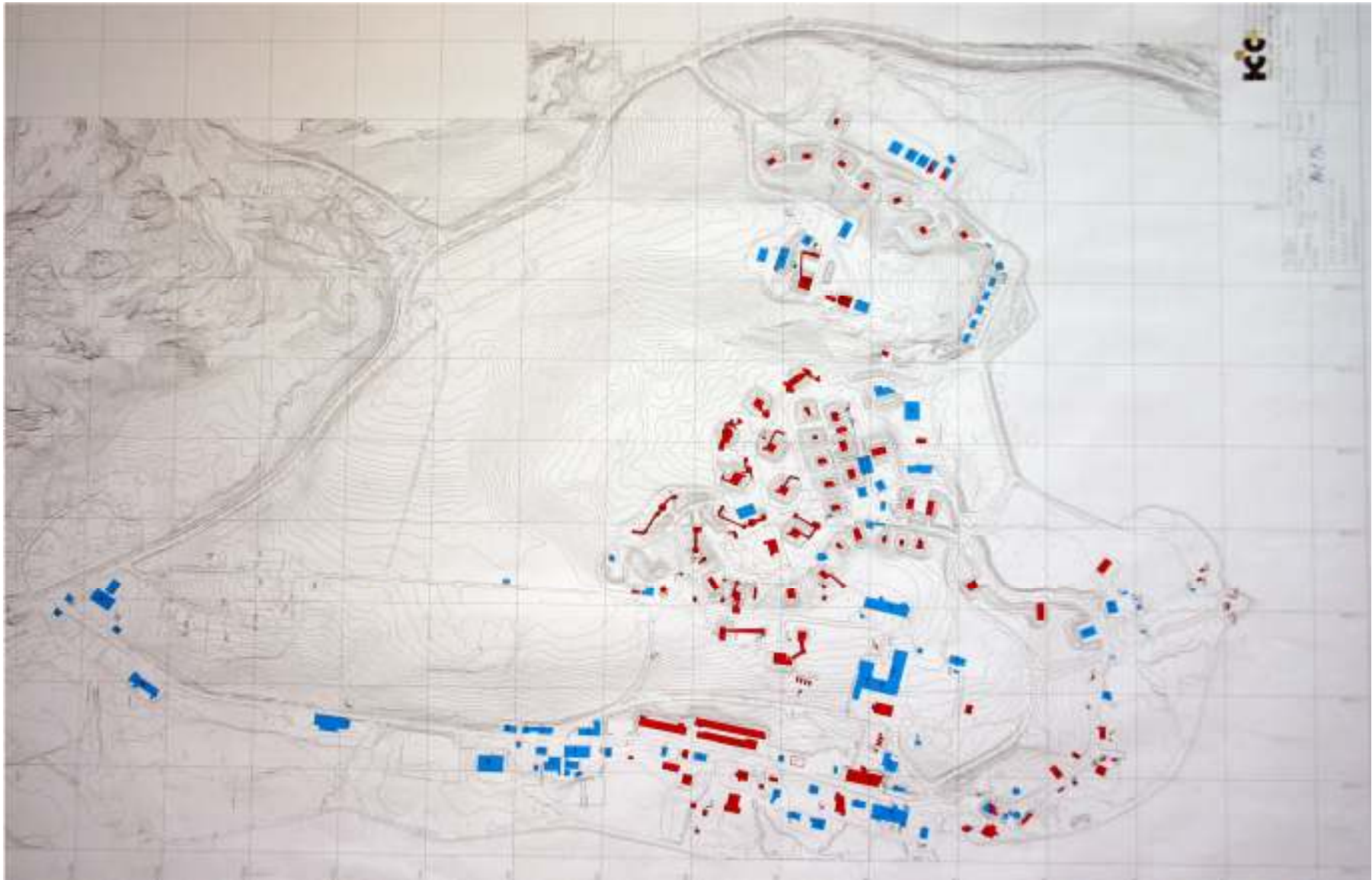
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Phase 1. Buildings.

- **We established a database for all the buildings at Gullaug Plant, where we registrated all historical information about activities in the building.**
- **This ended up with aprox 100 what we called "Red buildings" where we had produced / handled explosives.**
- **The conclusion was that all this buildings should be demolished incl. the floor.**



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Phase 1. Buildings. Conflicts.

- **A lot of this buildings were "very old", and the local authorities wanted to keep some of these as "industrial cultural monuments".**
- **For us this was a conflict regarding safety in the future.**
- **We had discussions with the national authority for explosives, and they formed a letter that "due to safety aspects" should all this buildings be demolished.**

Phase 2. Practically work.

Demolition of buildings:

- 1. Blasting of the process waste water system using 100 gr. detonating cord.**
- 2. "Cleanburning" of the buildings and some of the process equipment using wood, and making sure that we reached high enough temperature.**
- 3. Demolition of the buildings using hydraulic "scissors" and *not* hydraulic hammer.**

Phase 2. Practical work. Experience.

- **Blasting of the waste water system.**
 - we registered "with drag" that in some cases resulted in that the floor was demiloshed.
- **"Clean burning" of buildings.**
 - we registered minor detonations in the buildings during the fire.
- **Excavation in connection to demolish the floor.**
 - we had a delflagration prox 1 m under the floor
- **Everything documented on video.**



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Status to day.

- All mapping / sampling done.
- All waste water systems blasted.
- 80% of "Red buildings" are "cleanburned"
- Aprox 3000 m² buildings are demolished incl the floor.
- 6400 ton of building materials are shipped to a disposal site.

- *All this work done without accidents.*
- *We have used the "Take 5" consept to Dyno Nobel.*