controlled blasting in rock

Expansion to 500 MW of the Theun, Hinboun power plan, civil works construction Bolikhamxay and Khammouane Provinces, Laos

Excavation of a pit close to preexisting power plant with turbines spinning

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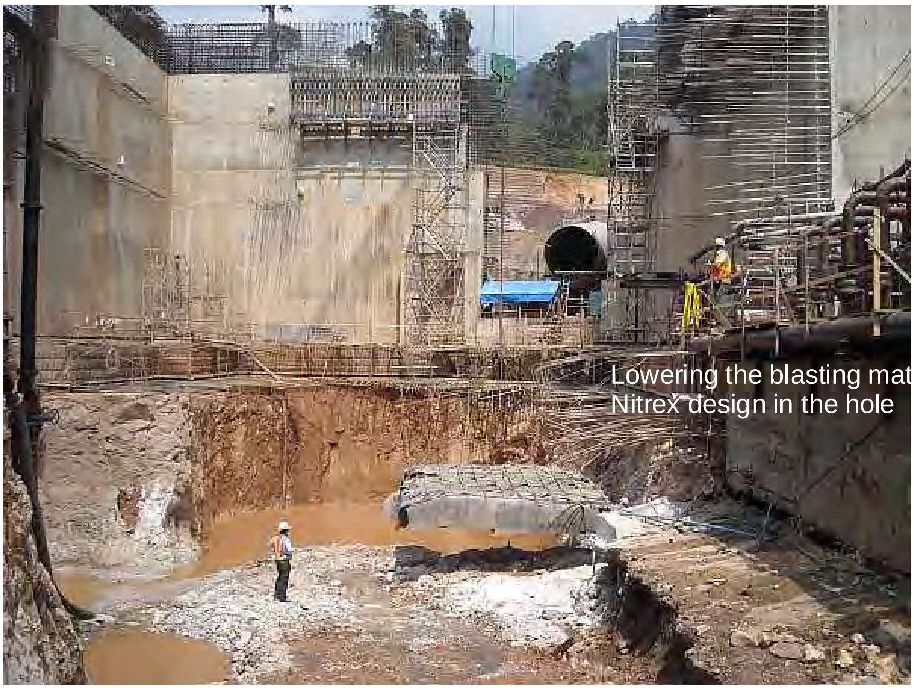
Job performed for **CMC Ravenna Italy**, year **2010**

The job

To double the power plant it was necessary to dig a 20 meters deep hole for about 40k m^3, by the preexisting plant. Upper clay overburden was removed by backhoe excavators and a layered limestone formation was demolishes by means of boreholes small diameter and emulsion explosives. Due to the close proximity to the existing powerhouse which had to be kept working, to produce electricity, the impact due to the explosion had to be kept under control and a maximum velocity of 4 mm/s was imposed by the spinning turbines at the basement. This low threshold had to be kept because the turbine monitoring system was programmed to stop automatically with a detected speed on the axe of 6 mm/s, this as warning in case of mechanical malfunctioning which could bring to seizure.

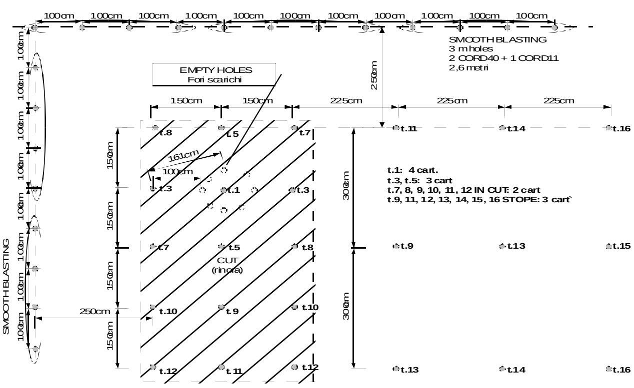


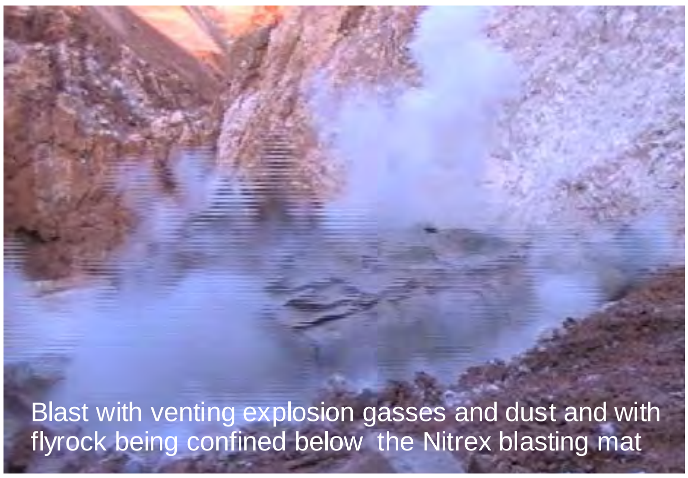
Lowering the blasting mat Nitrex design in the hole

Design and and field activity

An ACCEPTORS DATABASE was set up, with data on the ACCEPTORS (the surrounding structures and plants to be safeguarded).
Also geo-mechanical parameters of the rock to be blasted were defined on the base of preexisting reports and of on field surveys.
Design was structured in GUIDELINES were the controlled blasting was exposed and presented to supervisors, as well as a decay curve of the seismic waves induced by the blast referring to previous similar jobs.
Care had to be taken also for flyrock due to proximity of a golf court and, over all, of the high voltage cable from the power plant.
Also MONITORING SPECIFICATION were given, for measurements of the blast induced seismic waves to be performed H24 close to the turbines and to the civil works for the whole duration of the job (5 monitoring spots).
Operation procedure was given in a METHOD STATEMENT and a HEALTH AND SAFETY PLAN with RISK ASSESSMENT.
DAILY REPORTs including recorded seismic waves, photo and video of each blast, were taken.

blasting mat Nitrex design in the hole prior to blast

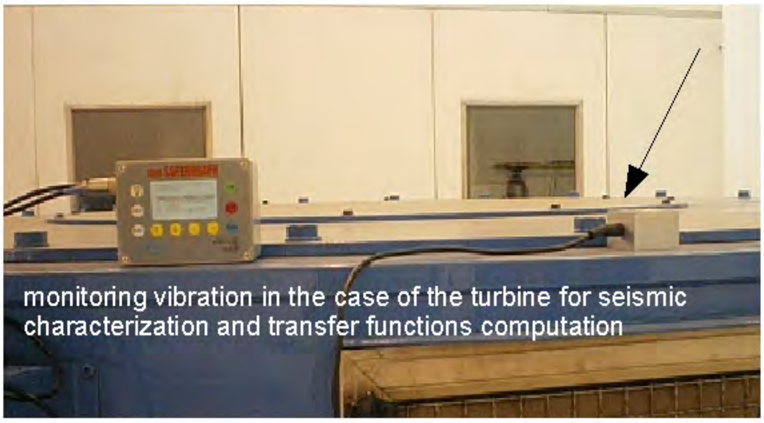




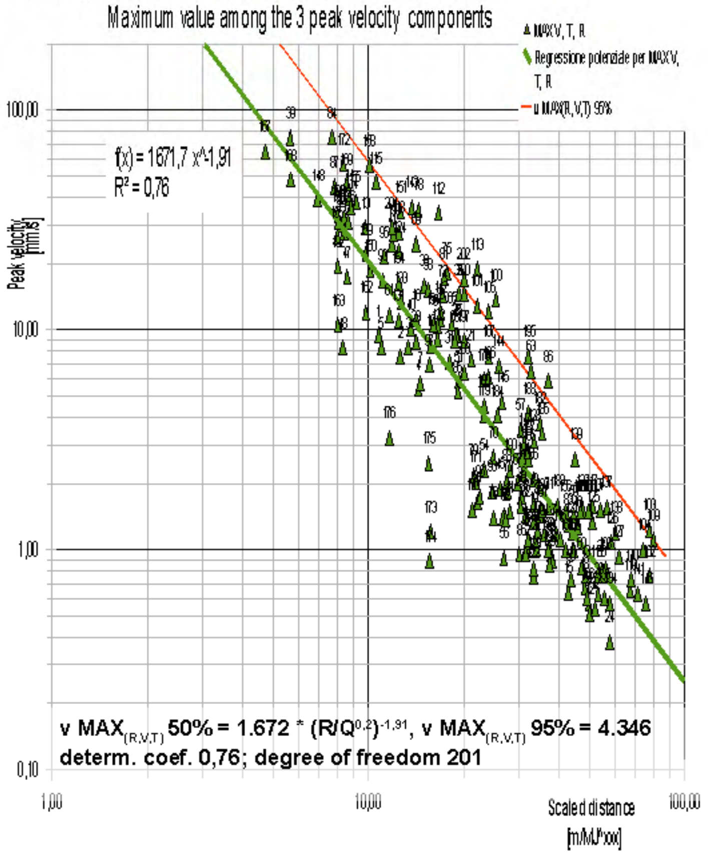
Blast with venting explosion gasses and dust and with flyrock being confined below the Nitrex blasting mat


upper room of the power plant with the 2 turbines


ax of the turbine spinning tolerances in the magnitude of micrometers


monitoring vibration in the case of the turbine for seismic characterization and transfer functions computation

Peak particle velocity regression curve



v MAX$_{(R,V,T)}$ 50% = 1.672 * $(R/Q^{0.2})^{-1.91}$, v MAX$_{(R,V,T)}$ 95% = 4.346
determ. coef. 0,76; degree of freedom 201

Monitoring

Peak velocity decay curve was recomputed on the base of the recorded data and actualized monthly for best approximation in the maximum charge per delay to be blasted getting closer to the plant and turbines.
Cooperation of the charge was found at distances over 90 meters for sequential blasting of 25 ms.

Flyrock and blasting mats

Due to the lack in the country of steel-cable-blasting-mats, a venting blast cover was designed to capture or slow down rock flying apart from the blast. This, built with a double layer of thick reinforced belt conveyor bands sectioned in squares, was a safety precaution following a design focused in flyrock minimization.

Weather

Water from rain and also coming from fractures in the rock, slowed down operations and became a serious constraint which obliged to set a powerful dewatering system.