**Site Profile**
The Telangana State Govt. has decided to construct the Palamuru Ranga Reddy lift irrigation scheme (PRLIS) to cater the needs of irrigation in drought-prone uplands areas of Telangana region by drawing and lifting 90 TMC of water from foreshore of Srisailam reservoir. Telangana state irrigation & CAD department, who is the owner of the project, has awarded lift-II and lift-III to Mega Engineering & Infrastructure Ltd. Lift-II and lift-III are popularly known as package-5 and package-8 respectively. Both packages have several tunnel headings, surge pool and pump house (cavern) complex. Heading and Benching method is used construction of cavern. In the heading, MEIL uses Tamrock drill machines with drilling dia. of 45mm and 3.8 length. Charging was done by packaged 40 mm diameter emulsion explosive with electric detonators. The study was conducted in package 8 of MEIL.

**Site geology**
The rock of Package 8 (P-8) was grey/pink granite dissected by three sets of developed joints of vertical, horizontal and S3 type of joints. All three sets are mutually perpendicular to each other and forming medium to large sized blocks. One set is horizontal and remaining two sets are vertical. Presence of joints causes planer, as well as wedge failure in the headings and, is the main contributor towards overbreak. Further, the total tunnel construction and excavation work was in dry conditions.

**Observations**
Orica technical team visited the site for a site scoping to understand the situation. During visit following observations were made on site

1) Site was using 40mm cartridge (4 to 5 nos.) in periphery, which was providing excessive energy in the periphery leading to overbreak.
2) The holes in periphery were drilled at 600mm.
3) It was also observed that while drilling periphery holes the drill boom was not kept straight, which was leading to overbreak. Further, post blast only few half barrels were present which were also observed at angle, confirming the deviations in drilling.

**The Situation**
Package 8 (P-8) includes construction of one surge pool and one pump house with dimension 357m x 31m x 90 m and 402m x 26m x 61.50 m respectively. The drilling and blasting practices followed on site led to a lot of overbreak (up to one meter at some places) in the tunnel. With overbreak comes increased cost and compromised safety inside the tunnel, which was the main concern for MEIL. MEIL asked support from Orica to help them in reducing and solving the problem of overbreak.

---

**Figure 1: Underground Workings of P-8, PRLIS**

**Figure 2: Post Blast tunnel profile (before trial)**
**Technical Solutions**

Based on the geological conditions and resources, Orica proposed the concept of line drilling with alternate hole charging pattern. Charge density per meter of hole was kept low with decoupling ratio of 1.8. The cartridges of diameter 25 mm were used with the gap of 200 mm and inserted inside a hollow tube of diameter 32 mm. Use of hollow tube ensures even distribution of cartridges and proper stemming of uncharged collar. A detonating cord was attached to all cartridges for single initiation of charge.

For bench blasting in surge pool, method of pre-splitting was suggested with the firing of five holes at a time. The firing of five holes in a single shot produces a tensile stress in the rock, creating a planar crack between blast holes and maintains MCPD. Drilling of periphery holes was done with the spacing up to 10D. These closely spaced holes used in both line drilling and pre-splitting. Buffer holes were drilled at 80 cm from the perimeter holes, which was fully charged. In heading faces, burn cut pattern was followed to create an initial void.

All blast holes were suggested to charge with Orica emulsion explosives with use of non-electric detonators. The blast was designed with the help of Orica’s blast designing software like SHOTPlus™ and SHOTPlus™ Professional. Delay timings were decided and simulated on software before the blast for better results.

![Figure 3: Decoupled charges kept at distance in periphery](image1)

**The Trial**

With subject to the geological parameters of the rock We shifted all the peripheral holes down the periphery line varying 50 mm-200 mm at every gallery heading, slashing, and whole gallery face. The drilling crew was also trained to reduce angular deviations. In periphery, holes were drilling closely with spacing of 300 mm. Each peripheral hole was charged with using 25 mm explosive cartridge (4 to 5 nos.) in a PVC pipe. To further, reduce overbreak alternate holes were charged in the periphery.

![Figure 3: Profile line is marked 200mm inward the periphery](image2)

**The Result**

Controlled blasting techniques with SHOTPlus™ delivered the desired result without much overbreak. Overbreak was significantly reduced to less than 10 cm throughout the face boundary. Further, half barrels count also increased and were also observed straight, thus showing improving in drilling also.
Testimonial
With the help of controlled blasting techniques and customized solutions based on local geology and conditions, M/s Orica help us in the reduction of overbreak almost in all faces. Excellent results were obtained with an increase in blast size from 680 Cum to 2880 Cum per blast and minimal overbreak and undercut. Hoping collaboration of same kind with more dedication to produce much better results.

Mr. Uma Maheshwari Reddy
AVP, PRLIS (MEIL)

Acknowledgments
Orica wishes to thank the MEIL team for their enormous support during the implementation and permission to publish this case study.

Disclaimer
© 2014 Orica Group. All rights reserved. All information contained in this document is provided for informational purposes only and is subject to change without notice. Since the Orica Group cannot anticipate or control the conditions under which this information and its products may be used, each user should review the information in the specific context of the intended application. To the maximum extent permitted by law, the Orica Group specifically disclaims all warranties express or implied in law, including accuracy, non-infringement, and implied warranties of merchantability or fitness for a particular purpose.

The Orica Group specifically disclaims, and will not be responsible for, any liability or damages resulting from the use or reliance upon the information in this document. The word Orica and the Ring device are trademarks of the Orica Group.