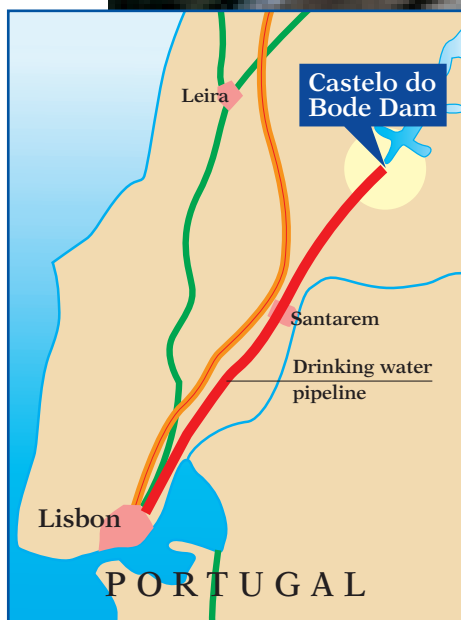
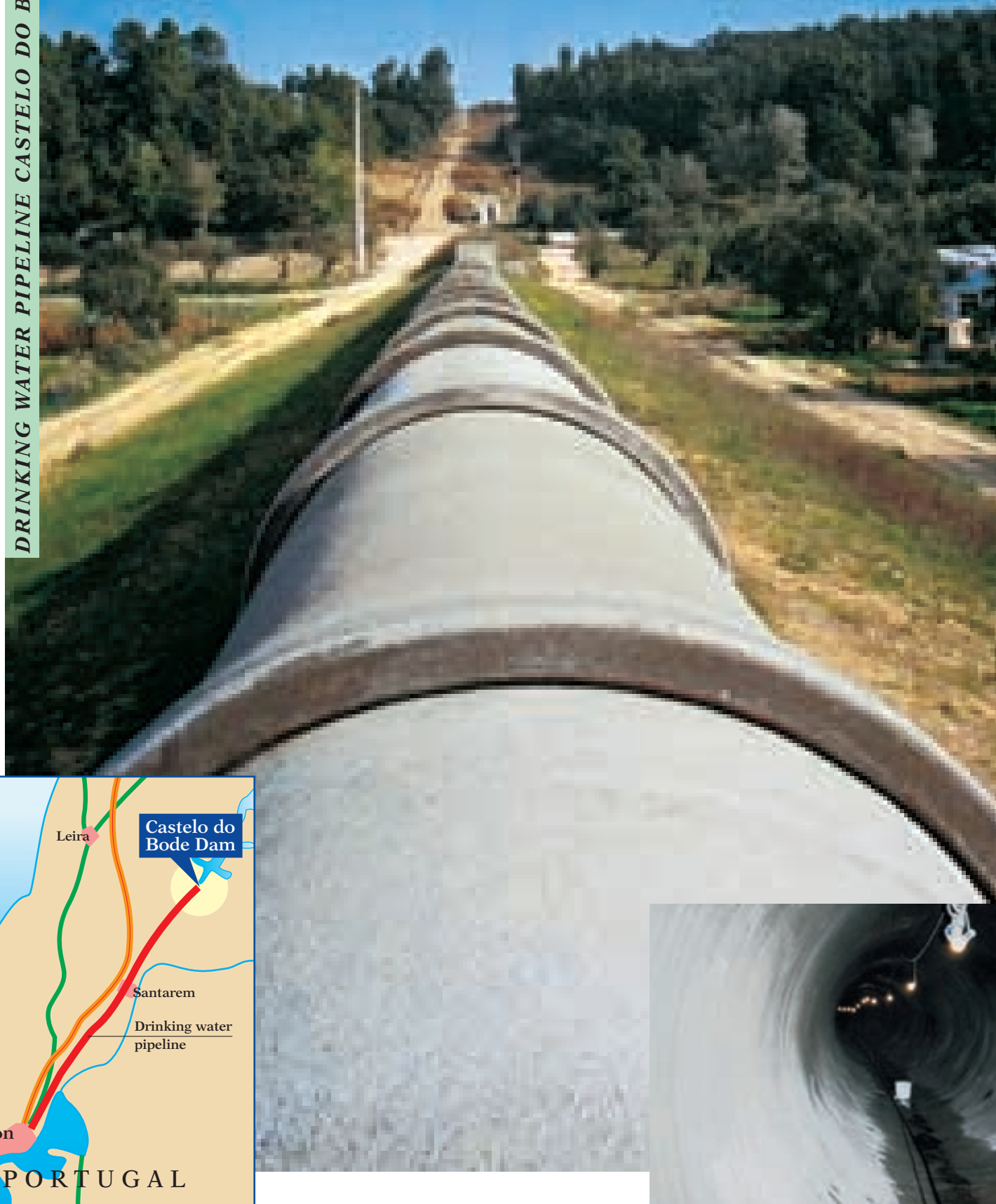
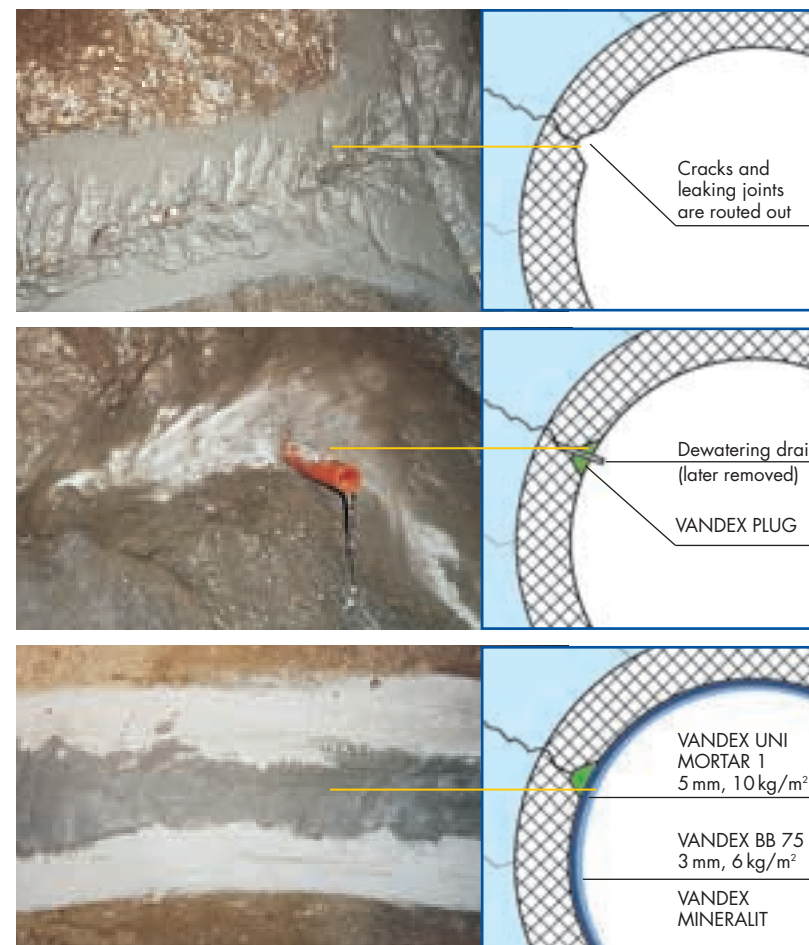


RENOVATION OF MAIN DRINKING WATER PIPELINE FOR LISBON, PORTUGAL



OPERATIONAL STEPS OF PIPELINE RENOVATION

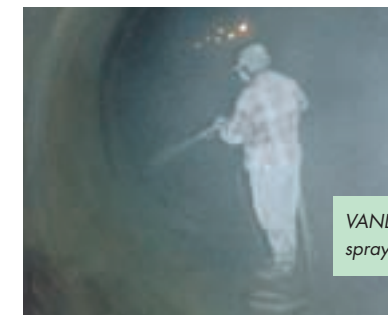


Castelo do Bode Subsystem Plans dating back to the 1930' were drawn up to build the Castelo do Bode Dam, to boost Lisbon's water supply and to generate electric power.

About 500,000 m³ of water per day are currently drawn from the intake located at the Castelo do Bode Dam. This is about $\frac{2}{3}$ of the total quantity supplied to the city of Lisbon by EPAL- Empresa Portuguesa das Águas Livres, S.A., the largest by far of Portugal's producers and distributors of potable water. This water, after treatment at the Asseiceira water treatment plant, is carried the 65 km to Lisbon by the Castelo do Bode pipeline. Made of pre-stressed concrete and reinforced concrete mixed on site, the pipeline has an inside diameter ranging from 1,500 to 2,500 mm.

One 12 km long segment of this pipeline, located between Várzea das Chaminés and the Vila Franca de Xira pumping station, is buried 3 to 6 metres deep and was built "in situ" in 1988. When this segment showed concrete deterioration and damaged joints, EPAL invited REDECOR, who represent VANDEX International Ltd in Portugal, to consider a concept for repairing those defects and providing future protection of the pipeline.

Redecor began by carrying out tests with VANDEX PLUG, VANDEX UNI MORTAR 1, VANDEX BB 75 and VANDEX MINERALIT on the inner surface of the pipe, which then carried water as usual for a period of six months. At that point, the tests were deemed successful and repair measures were started in accordance with the renovation concept (see box).



VANDEX BB 75
spray application

During the rainy season the pipe, showed sizeable rainwater leaks. These ceased after installing drains and plugging with VANDEX PLUG (see drawings).

After the leaks were plugged, coating took place on the inner surface of a 2 km long section of pipe, with an inside diameter of 2,500 mm.

REPAIR AND RENOVATION CONCEPT

- High-pressure water- and sandblasting of the corroded concrete surface, steel reinforcement.
- Plugging of leaks in pipe joints and cracks (necessary before coating inner surface).
- Coating reinforcement with VANDEX CRS CORROSION PROTECTION EP.
- Levelling and protection of concrete surface with 5 mm thick overall coat of VANDEX UNI MORTAR 1.
- Protection of bottom of pipe (approx. $\frac{1}{4}$ of inner surface) with 10 mm thick layer of VANDEX UNI MORTAR 1.
- Final coating with a 3 mm thick coat of VANDEX BB 75 for waterproofing, concrete protection and smooth surface to cut down on flow loss due to hydraulic friction.
- Surface hardening of final coat with VANDEX MINERALIT.

The VANDEX products used in this project:

VANDEX UNI MORTAR 1	170 tons
VANDEX BB 75	82 tons
VANDEX SUPER	1 ton
VANDEX PLUG	3 tons
VANDEX MINERALIT	1 ton

Owner: EPAL Empresa Portuguesa das Águas Livres, S.A.;
Engineer: EPAL; Main contractor and VANDEX
Applicator: REDECOR, P-1100 Lisbon