A novel cooling solution for an intersection of a 2x2 duct bank with HV cables crossed by a steam pipe

George **ANDERS** (1), Heinrich **BRAKELMANN** (2), Sudhakar **CHERUKUPALLI** (3)

1 Lodz University of Technology, Lodz, Poland, george.anders@bell.net
2 BCC Cable Consulting and University of Duisburg, Germany, heinrich.brakelmann@ets.uni-duisburg-essen.de
3 BC Hydro, Vancouver, Canada, sudhakar.cherukupalli@bchydro.com

This paper presents the results of ampacity studies and proposed remedial actions for the situation where a steam pipe crosses a duct bank with HV transmission cables.

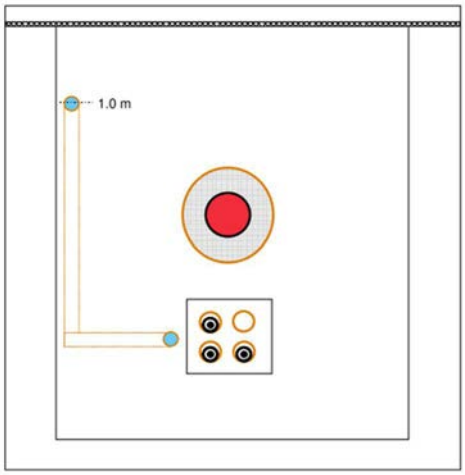
A 2X2-transmission duct-bank intersects a steam crossing in downtown Vancouver. This intersecting steam line, which was super-insulated, is likely to pose some concern for long-term thermal performance of the transmission cable and appears to be thermally limiting for the cable corridor. There is an urgent need to develop a solution to mitigate this “hot spot” and to allow the transmission cable to be able to carry its rated current (1250A). The soil temperature measured below the steam pipe at the depth of proposed transmission duct bank prior to its installation ranged from 35°C to 45°C.

In the first set of studies, two computer programs (CYMCAP and KATRAS) were used to model the situation when the steam pipe is parallel to the duct bank and then further calculations were performed with the 90° crossing. The calculations were performed with the thermal parameters of the steam pipe insulation supplied by B.C. Hydro and confirmed with the internet data about the thermal properties of the insulation materials of the steam pipe.

In the additional studies, the measurements performed by B.C. Hydro were used to determine the most likely equivalent thermal resistivity of the steam pipe insulation and to determine under what conditions the cable conductor temperature might exceed the allowable limit. Taking the nominal values for the steam pipe insulation parameters, the equivalent thermal resistivity of this insulation is estimated to be equal to 19.2°K.m/W. Taking into account a possible aging, however, as well as the measured temperature values, the estimated value of this parameter is more likely to be 9.6°K.m/W.

The second set of studies involved application of a new solution involving use of the gravitational water cooling system. The system is described in detail in the paper. Mathematical models for several possible solutions involving both water and air gravitational cooling, taking the crossing geometry into account, were developed. Practical concerns of BC Hydro engineers involving safety and public utility regulations as well as practicability of the proposed solution are also discussed in the paper.

The diagram shows the proposed solution with the gravitational water cooling pipes. In this case, the steam pipe crosses the duct bank at 90°C; however, both the parallel and angled crossing situations can be investigated by the proposed model.



The major findings of the studies can be summarized as follows:

- In the most adverse condition of the soil and the steam pipe coating the conductor temperature will exceed 90°C notwithstanding the effort to increase duct spacing at the intersection to improve the cable’s thermal performance.
- Remedial action involving water pipes seems to be both inexpensive and effective solution for cooling down the intersection of the steam pipe with the duct bank thus ameliorating the anticipated thermal limit for the cable ratings.