protection CDs, the required number of anodes is increased, and maximum anode distance is reduced. At extreme protection CD of 5,000 mA/m^2, the anode spacing is <100 m and the CP capacity is almost three times the conventional capacity.

Table 3 illustrates how the variation in the relative permeability is a key factor and creates a potential difference to calculate the anode capacity required for each zone, in addition to the maximum AC density limit for the selected type of anode. The best case condition shows that 12 anodes are required for each zone, while the number of required anodes is 50 in the worst case condition (almost four times of the best case condition status).

Table 4 presents the obtained voltages with different coating defect sizes; for example 6.19 Vac is obtained with a defect size of 1 cm^2. This value must be considered during design of the DEH system and the AC voltage profile along the pipeline should be verified to minimize the probability of the AC corrosion. In conclusion, an appreciable ohmic resistance may reduce the risk for AC corrosion.

For example, a conventional CP system required only 40 anodes, while total anodes for both CP and DEH systems can be derived from both Tables 2 and 3 with a worst case condition of up to 324 anodes (eight times the required anodes in the conventional case). Results show that the effects of the CP system anodes on the DEH system and vice-versa should be considered.

Furthermore, it should be noted that the outer sheath of the piggyback cable cannot withstand high induced voltage in the screen, so avoiding a high screen voltage to ground in long piggyback cables must be considered. Different methods for solving this problem have been evaluated. A new cable design with a semi-conductive outer sheath has been adopted to enhance the electrical efficiency of DEH-WIS.

What makes the DEH-PiP system complex is that the production pipeline is being employed in a manner similar to high-voltage power cables. There is extruded high-quality electrical insulation around the production pipe, followed by a thin semi-conductive layer, a purity free annulus, and semi-conductive centralizers to safely conduct capacitive charging currents to ground. The major disadvantage is that the most vulnerable electrical component, the mid-line electrical connector, is not reparable.

For comparing the PiP system to WIS, this solution presents higher power efficiency as there is no communication with the seawater. At the outer pipe, the voltage is near zero, so that the current path is clearly defined, maintenance free, and a more cost-effective solution. Finally, Table 1 provides a guideline for the selection based on advantages and drawbacks for each system.

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