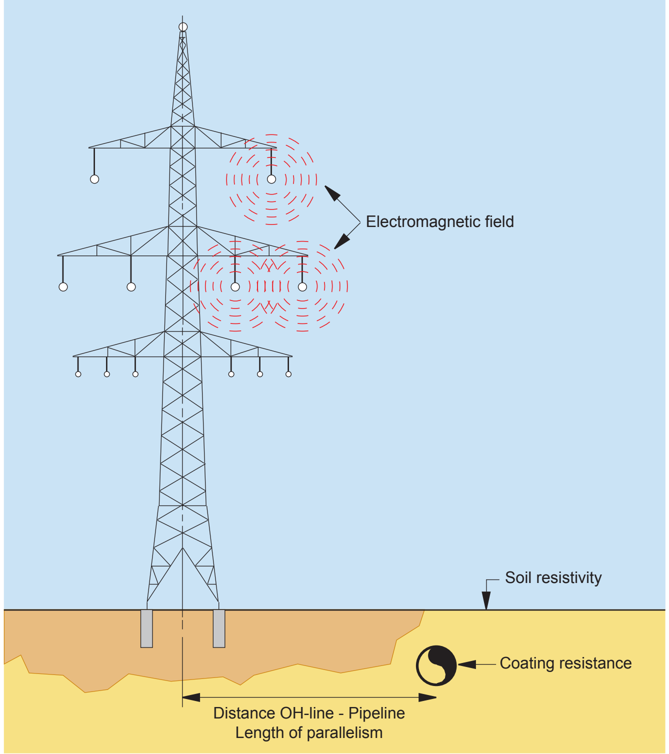
German Cathodic Protection

Pipeline Routing

There are many important points to be considered when selecting the right pipelines routes. These include environmental impact, legal requirements for planning permission and land use, as well as constraints from nearby housing or industrial facilities. as result it is often necessary to use already existing high voltage overhead power supply corridors.

Inevitably results in crossings and parallel locations of various routes which can lead to interference and an increased of danger of high voltages to personnel and equipment. Technical measures needed to reduce this potential danger to personnel and equipment will require additional planning and expenditures.

Reduction of this potential danger for personnel and equipment is only reached by high technical and econonomical efforts.



Calculations of induced contact voltages

The basic elements of calculating induced contact voltages and the necessary preventive/corrective measures are well known. Previously, the conventional method was to use a combination of estimations, empirical values and calculations. We have developed a special computer to calculate induced contact voltages. It also allows calculation of close proximity sections and the optimisation of any required earthing and mitigating measures.

The HVIC program allows a computer simulation of overhead line and pipeline configurations so that any changes in the operating parameters can be considered for critical sections.

Gathering Information

Information gathering is the most important part in solving of high voltage interference problems.

The information requiredincludes:

- The layout drawings of pipelines and high voltage overhead lines routes.
- Top-view scale drawings or maps of the entire geographical area of interest, showing all conductors (pipelines) under study in sufficient detail, as well as any other major installations.
- High voltage overhead line and pipeline details include:

Pipeline data

- Material specifications
- Outside diameter
- Coating resistance
- Buried depth
- Specific soil resistivity

High voltage overhead line data

- X-Y Tower coordinates of conductors
- Maximum conductor sag
- Height of towers
- Type of conductors
- Type of earthwire on top
- Maximum operating current
- Operating frequency
- Short circuit earth fault current
- Neutral point of system

PC-based Computer Program

The PC-based computer program includes comprehensive electromagnetic coupling equations with an easy-to- use interface format to enable both operating and short circuit conditions to be calculated for up to five unbonded pipelines co-located with up to twenty power transmission line circuits.

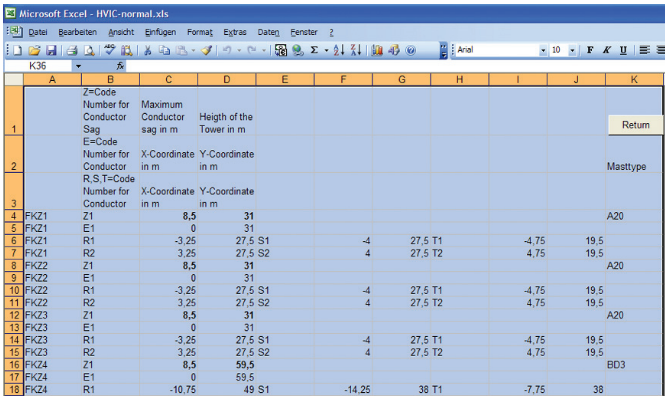
The program also provides enhanced analysis and assessment of pipeline bonding connections and pipeline earthing measures for both operating and short circuit mitigation. The format developed for this program makes many of the computational functions and much of the data input automatic for the user, thus leading to considerable simplification in program usage.
Data input for few computer screens are required to fully exercise the program.

Advantages

The software considerably reduces necessary working time and operational costs involved in solving AC induced problems, preparing studies of inductively coupled interference, design and planning of new cathodic protection systems for co-located pipelines and overhead voltage transmission lines, planning of crossings and right-of-way and risk assessment.
The program can be used by pipeline engineering staff and contract consultants to reduce necessary engineering costs and time while improving the safety and integrity of cathodic protection design.

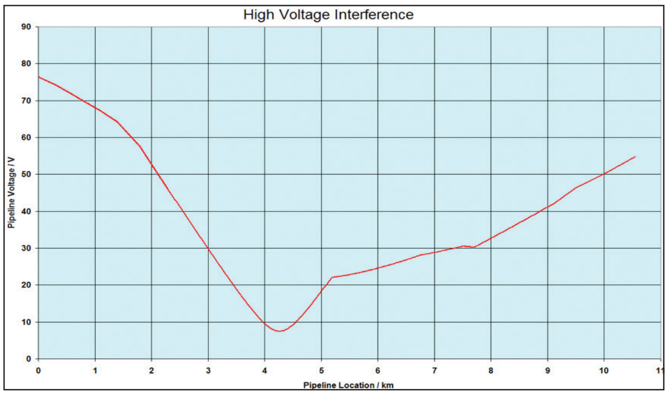
Standards and Guidelines

In 1977, the NACE recognised the problem of induced AC on pipelines and issued a Standard Recommended Practice to control corrosion and safety issues.
In 1995, this standard was updated and re-issued as Standard RP-01-77-95 „Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems".
The Canadian standard is CAN/CSA-C22.3 No. 6-M91 „Principles and Practices of Electrical Coordination between Pipe Lines and Electric Supply Lines".
Standards also exist in Europe, such as DIN VDE 0141 (Beuth-Verlag, Berlin, 1976).
The NACE and Canadian standards recommend that the potential on a pipeline from AC be reduced to less than 15 V AC. European standards recommend a reduction to less than 60 V AC.

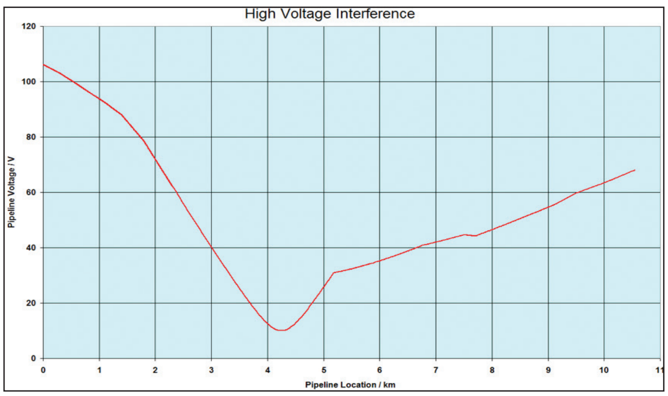

Microsoft Excel - HVIC-normal.xls

	A	B	C	D	E	F	G	H	I	J	K
1		Z=Code Number for Conductor Sag	Maximum Conductor sag in m	Heigth of the Tower in m							Return
2		E=Code Number for Conductor	X-Coordinate in m	Y-Coordinate in m							Masttype
3		R,S,T=Code Number for Conductor	X-Coordinate in m	Y-Coordinate in m							
4	FKZ1	Z1	**8,5**	**31**							A20
5	FKZ1	E1	0	31							
6	FKZ1	R1	-3,25	27,5	S1	-4	27,5	T1	-4,75	19,5	
7	FKZ1	R2	3,25	27,5	S2	4	27,5	T2	4,75	19,5	
8	FKZ2	Z1	**8,5**	**31**							A20
9	FKZ2	E1	0	31							
10	FKZ2	R1	-3,25	27,5	S1	-4	27,5	T1	-4,75	19,5	
11	FKZ2	R2	3,25	27,5	S2	4	27,5	T2	4,75	19,5	
12	FKZ3	Z1	**8,5**	**31**							A20
13	FKZ3	E1	0	31							
14	FKZ3	R1	-3,25	27,5	S1	-4	27,5	T1	-4,75	19,5	
15	FKZ3	R2	3,25	27,5	S2	4	27,5	T2	4,75	19,5	
16	FKZ4	Z1	**8,5**	**59,5**							BD3
17	FKZ4	E1	0	59,5							
18	FKZ4	R1	-10,75	49	S1	-14,25	38	T1	-7,75	38	

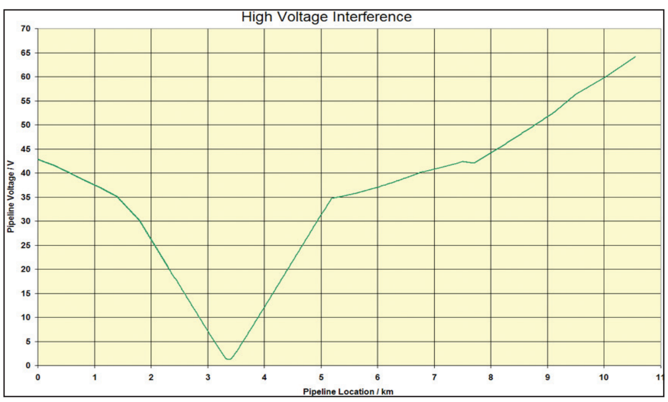
Example of data input for calculation by using Microsoft Excel™



Calculation results caused by overhead line **operating currents** without any earthing measures



Calculation results caused by overhead line **short circuit currents** without any earthing measures



Calculation results caused by overhead line **operating currents** with earthing measures (U_{max} < 65 V according to German Standard)