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SERIES K: PROTECTION AGAINST INTERFERENCE

Operator responsibilities in the management of electromagnetic interference by power systems on telecommunication systems

Recommendation ITU-T K.68

ITU-T



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Operator responsibilities in the management of electromagnetic interference by power systems on telecommunication systems

Summary

Recommendation ITU-T K.68 deals with the management of electromagnetic (e.m.) interference produced by electric power systems and electrified traction systems on telecommunication systems.

This Recommendation defines the procedure to evaluate the acceptability of an e.m. interference and gives:

- the criteria defining the interference situations to be examined;
- the interference management voltages to be applied;
- the installation conditions of electric power, electrified traction and telecommunication systems under which the management voltages are applicable.

This Recommendation establishes an official agreement between telecommunication operators and power and railway operators in order to clearly share responsibilities, and, as a consequence, if necessary, the relevant expenses for mitigation measures.

Source

Recommendation ITU-T K.68 was approved on 13 April 2008 by ITU-T Study Group 5 (2005-2008) under Recommendation ITU-T A.8 procedure.

Keywords

Damage, danger, disturbance, immunity, malfunction, noise, power frequency interference, resistibility, responsibility, safety.

FOREWORD

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Introduction

The Directives (*Directives concerning the protection of telecommunication lines against harmful effects from electric power and electrified railway lines*) are the reference documents dealing with the electromagnetic interference (e.m. interference) produced by electric power systems and electrified railway systems on telecommunication systems. The Directives (1988, 1989, 1999 and 2008 editions) are divided into 9 volumes, each dealing with a separate part of the overall subject. Their use can be guided as follows:

- For a broad understanding of telecommunication, power and railway facilities and their mutual coupling effects, consult Volume I.
- For further information on inducing installations in power or electrified railway systems, consult Volume IV (railway systems) or Volume V (power systems).
- For understanding the physical-mathematical theory of the e.m. interference and to know calculation methods, at various levels of detail and precision, consult Volumes II and III.
- To understand the effects of induced voltages and currents, i.e., danger, damage and disturbance, and the recommended permissible values, consult Volume VI.
- For advice on protective components or complex protective devices, consult Volume VIII.
- For information on relevant testing and measuring techniques, consult Volume IX.

NOTE – The content of the Directives has been formally agreed by ITU, CIGRE and UIC.

Since their first edition (1952), the Directives have been the worldwide reference text in the field of e.m. interference, used for establishing regional or national standards, even for topics not identical to the ones dealt with in the Directives but strictly related to them, like e.m. interference produced by electric power systems and electric traction systems on pipelines or metallic structures.

The Directives were established when the number of actors involved in e.m. interference was low. Even if, in some countries, the liberalization in telecommunication, energy and transportation dates back a long time, in many countries there was only one telecommunication company, one energy company, one railway company. The solution of e.m. interference problems was managed by few specialists and had the character of scientific study. Now the number of actors is highly increased, and the solution of the e.m. interference problems must be treated as a normal design activity and the need of information and the guidance of such actors are necessary.

The Directives contain a very large amount of valuable information both at the scientific and practical design levels. Therefore, there is the need to guide through this information the mainly small companies or companies who could face the e.m. interference problems for the first time.

In fact, the Directives do not answer the following questions:

- 1) *who* is responsible for the e.m. interference;
- 2) *when* the e.m. interference has to be evaluated;
- 3) *how* this evaluation shall be carried out.

This Recommendation deals with the management of the e.m. interference; in particular, it aims to define:

- the maximum distance between the involved plants for evaluating the e.m. interference (*when*);
- the conditions (installation conditions, working conditions, energy flow, etc.) of the involved plants to which the management voltages are related (*how*);
- the Operator's responsibilities for the e.m. interference (*who*).

This Recommendation deals with all the aspects of the management of e.m. interference in a comprehensive manner.

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Recommendation ITU-T K.68

Operator responsibilities in the management of electromagnetic interference by power systems on telecommunication systems

1 Scope

This Recommendation gives the criteria defining situations to be examined and the installation conditions of both power and telecommunication plants under which the management voltages are applicable to the e.m. interference produced on telecommunication systems by the following power systems:

- a.c. electric power systems;
- d.c. electric power systems;
- a.c. electrified traction systems;
- d.c. electrified traction systems;

resulting from the following physical mechanisms:

- inductive coupling;
- conductive coupling;
- capacitive coupling;

for different power system conditions:

- normal;
- fault;

in the frequency range 0 Hz to 9 kHz.

It covers the resulting effects of:

- danger to people;
- damage to the telecommunication system;
- disturbance to the telecommunication system (malfunction, noise).

This Recommendation is applicable to all telecommunication lines with metallic elements. Fibre-optic cables are to be considered only if a metal conductor, screen or sheath, is included in their construction.

The objective of this Recommendation is to establish:

- the procedure for evaluating the e.m. interference (clause 4);
- the maximum distance between power and telecommunication plants for studying the e.m. interference between them (clause 5);
- the installation conditions (clause 7) of both power and telecommunication plants under which the interference results shall be evaluated (through calculations in accordance with volume II or III of the Directives, through measurements, or through a suitable combination of both) in order to check the compliance (clause 8) of the induced voltages on the telecommunication line with the appropriate management voltages (clause 6);
- an official agreement between telecommunication operators and electric power and electrified railway operators in order to clearly share responsibilities and, as a consequence, if necessary, the relevant expenses for mitigation measures (clause 9);

- a reminder of the need to maintain a suitable monitoring of the technical characteristics evolution of the plants involved in the interference to avoid, due to modifications, an acceptable interference evolving into an unacceptable one (clause 10).

This Recommendation is applicable to all situations where a private or public telecommunication plant is liable to be influenced by one or more power plants.

This Recommendation is applicable to new telecommunication and new power plants and also to existing plants where modifications are proposed, such as changes of system earthing, line configuration, operating voltage and fault current (also due to modifications in plants connected to another under consideration), which will significantly increase the existing levels of e.m. interference.

This Recommendation shall be used in the determination of the types of coupling to be considered for various power system operating conditions, and in the comparison of predicted induced voltages with the management voltages given in clause 6.

This Recommendation does not apply to e.m. interference from electric power systems with a nominal operating voltage below 1 kV.

The definition of the mitigation measures, if necessary, is outside the scope of this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions, which through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T K.10] Recommendation ITU-T K.10 (1996), *Low frequency interference due to unbalance about earth of telecommunication equipment*.
- [IEC 60050-161] IEC 60050-161 (1990), *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*.
<<http://webstore.iec.ch/webstore/webstore.nsf/artnum/000397>>
- [IEC 60050-448] IEC 60050-448 (1995), *International Electrotechnical Vocabulary – Chapter 448: Power system protection*.
<<http://webstore.iec.ch/webstore/webstore.nsf/artnum/018396>>
- [IEC/TS 60479-1] IEC/TS 60479-1 (2005), *Effects of current on human beings and livestock – Part 1: General aspects*. <<http://webstore.iec.ch/webstore/webstore.nsf/artnum/034455>>

3 Definitions

This Recommendation defines the following terms:

Unless defined in this Recommendation, the definitions given in [IEC 60050-161] and [IEC 60050-448] shall be applicable.

3.1 system: Generic word to encompass all the elements, parts, equipment connected together, of a given technology (electric power system, electrified traction system, telecommunication system).

3.2 a.c. electric power system: Electrical system, operating with alternating current (a.c.), devoted to electrical energy transmission and distribution.

NOTE – Two-phase power systems operating at 16⅔ Hz dedicated to the supply of a.c. electrified traction systems shall be considered as a.c. electrified power systems, even if the relevant conductors are placed on the same poles of traction lines.

3.3 d.c. electric power system: Electrical system, operating with direct current (d.c.), devoted to electrical energy transmission from substation to substation.

NOTE – These substations are in fact a.c./d.c. rectifier stations and d.c./a.c. inverter stations.

3.4 a.c. electrified traction system: Electrical system, operating with alternating current (a.c.), devoted to electrical energy supply from traction substations to electric train units: the return path, metallic conductors and/or earth, is part of the traction system.

3.5 d.c. electrified traction system: Electrical system, operating with direct current (d.c.), devoted to electrical energy supply from traction rectifier stations to electric train units: the return path, metallic conductors and/or earth, is part of the traction system.

3.6 power system: General expression encompassing, in this Recommendation, both electric power systems and electrified traction systems.

3.7 wireline telecommunication system: A system which is able to transmit information between two or more points by means of physical links. The wireline telecommunication systems to be considered in this Recommendation are those with metallic parts (e.g., metallic pair, cable sheath, reinforced fibre-optic, etc.: the fibre optic itself is not involved in the physical phenomena dealt with in this Recommendation).

3.8 plant: A part of a system which is involved in an e.m. interference problem with one or more plants of other systems:

- a plant may be a power line connecting two substations or a substation (power plant);
- a plant may be a traction line connecting two railway stations or a feeding station (power plant);
- a telecommunication line connecting two exchanges or connecting an exchange to several customers through a single cable from the exchange, which is subdivided into several branches at cabinets (telecommunication plant).

3.9 normal operation: Operation of any system, which is deemed to be fault free. Transient phenomena due to switching taking place on power systems are considered to be normal.

3.10 fault condition (for power systems): Unintentional connection via contact, arc, etc. of an energized conductor to earth or to any earthed metallic object, i.e., shunt fault, or unintended disconnection or breakage of current-carrying conductors (including return path for traction systems), i.e., series fault.

Fault condition also includes cases of a short circuit between any two phases or one phase disconnected ("one-phase off").

3.11 fault duration: Time duration for which a single fault condition lasts.

NOTE – The fault duration of a shunt fault is determined by the fault clearance time, which is the time interval between the fault inception and the fault clearance [IEC 60050-448].

3.12 reference fault duration: The duration of the longest current interruption time of the associated circuit-breaker(s) for elimination of fault current in the case of correct operation of protection. When high impedance earth faults should also be considered, the reference earth fault duration is associated with the longest interruption time for the elimination of at least 65% of the total number of earth faults. [IEC 60050-448].

NOTE – The correct operation of protection means the initiation of a tripping signal and other commands from a protection in the intended manner in response to a power system fault or other power system abnormality and the operation of the circuit breaker(s) corresponding to the tripping signal.

3.13 e.m. interference: Electromagnetic phenomenon (explained by means of the three types of electromagnetic couplings), which a power plant can create in a neighbouring telecommunication plant and which may cause danger, damage or disturbance, on the latter.

3.14 inducing: Adjective used to identify the plant producing the e.m. interference and the relevant quantities (inducing line, inducing current, inducing voltage, etc.).

3.15 induced: Adjective used to identify the plant affected by the e.m. interference and the relevant quantities (induced line, induced current, induced voltage, etc.).

3.16 inductive coupling: Phenomenon whereby the magnetic field produced by a current-carrying line (inducing conductor(s)) influences another line (induced conductor(s)), the coupling being quantified by the mutual impedance between the two conductors with common earth return. The current carried by the inducing line is the inducing current.

3.17 capacitive coupling: Phenomenon whereby the electric field produced by a voltage-carrying line (inducing conductor(s)) influences another line (induced conductor(s)), the coupling being quantified by the capacitance coefficients between the conductors and between each conductor and earth. The voltage carried by the inducing conductor is the inducing voltage.

3.18 conductive coupling: Phenomenon whereby the current flowing from a conductor structure (inducing conductor(s)) to the earth influences another conductor structure (induced conductor), the coupling being quantified by the conductance between such conductors (structures). The current flowing from the inducing conductor to the earth is the inducing current.

3.19 danger: Effect of interference, which is able to produce a threat to a person in contact with the induced telecommunication plant.

3.20 damage: Effect of interference, which produces a permanent reduction in the quality of service, which can be offered by the induced telecommunication plant.

NOTE – When e.m. interference disappears, the damage remains. A damage requires a repair intervention.

3.21 disturbance: Effect of interference, which results in noise or malfunction of the induced telecommunication plant.

NOTE – When e.m. interference disappears, the disturbance disappears too. A disturbance does not require a repair intervention.

3.22 noise: Type of disturbance which produces a reduction in the quality of a voice-based service, which is offered by the induced telecommunication plant.

3.23 malfunction: Type of disturbance related to equipment installed along an induced telecommunication plant, resulting in loss of capability of equipment to initiate or sustain a manufacturer's declared function or the initiation of equipment emissions in excess of electromagnetic compatibility design limits.

3.24 influence distance: Distance from a power plant at which inductive coupling or capacitive coupling or conductive coupling or a combination of them can produce interference results on a telecommunication plant.

NOTE – From a theoretical point of view, the amount of the influence distance from a power plant tends to infinity: the larger the distance the lower the interference results.

3.25 reference influence distance: Maximum distance from a power plant at which exposure to interference must be considered.

NOTE – From the practical point of view, it is unnecessary to consider in this Recommendation distances greater than the reference influence distance.

3.26 induced length: The projection of a telecommunication line on an electric power or electrified traction line from the point at which a telecommunication line comes within the reference influence distance (d) of the electric power or electrified traction line and the subsequent point at which the telecommunication line moves beyond the reference influence distance (see Figure 1).

NOTE – The interference on the whole line should be examined when a part of the line or the whole line is within the exposure zone.

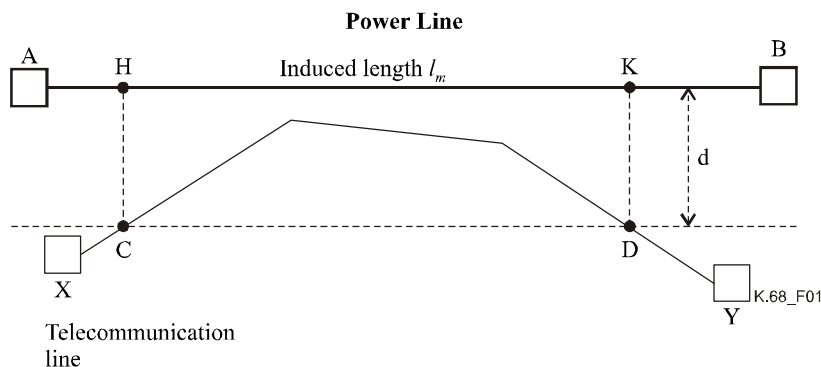


Figure 1 – Induced length

3.27 earth: The conductive mass of the earth, whose electric potential at any point is conventionally taken as equal to zero (in some countries the term "ground" is used instead of "earth").

3.28 induced voltage: Voltage produced in an induced telecommunication plant through e.m. interference due to one or more inducing power plants.

3.29 induced common mode voltage: The induced voltage common to all conductors of a group having identical common mode conditions appearing between that group and the earth at a given location of the telecommunication plant (see Figure 2).

NOTE – The highest common mode voltage generally occurs at one end of a conductor, when the other end of that conductor is earthed.

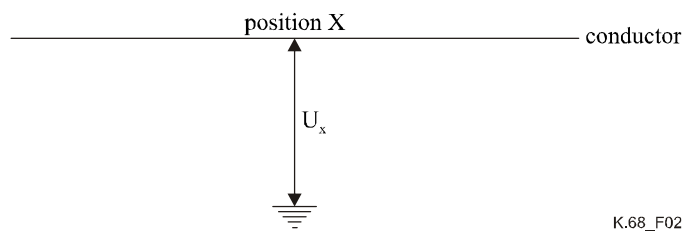


Figure 2 – Induced common mode voltage

3.30 induced differential mode voltage: The induced voltage between any two of a specified set of metallic conductors at a given location of the telecommunication plant (see Figure 3).

NOTE – Usually the voltage of importance is the one between the two conductors of a symmetrical pair. In some cases also, the voltage between two different pairs is important.

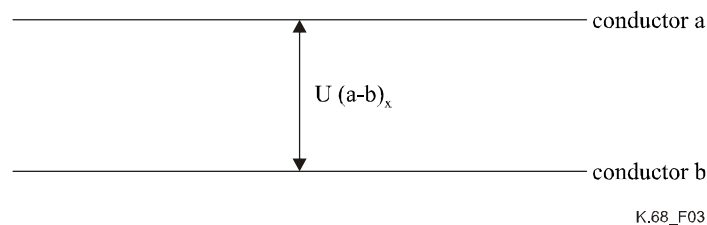


Figure 3 – Induced differential mode voltage

3.31 equivalent soil resistivity: Resistivity of homogenous soil representative of the various types of stratified soil present at the location of the considered power and telecommunication plants used for interference management.

NOTE – It is possible to have different values of the equivalent soil resistivity along the plants.

3.32 psophometric voltage or current: The psophometric voltage or current is the voltage or current on a telephone line (common or differential mode), U_p , or I_p , given by the expression:

$$U_p = \frac{1}{p_{800}} \sqrt{\sum (p_f U_f)^2} \quad [\text{V}] \quad (1a)$$

$$I_p = \frac{1}{p_{800}} \sqrt{\sum (p_f I_f)^2} \quad [\text{A}] \quad (1b)$$

in which:

U_f or I_f is the component at frequency f of the voltage [V] or of the current [A]

p_f is the weighting for this frequency, reflecting the responsiveness of the human ear to this frequency, given in the weighting table associated with the psophometer specification. The table in Appendix I gives values of p_f for the various frequencies, when p_{800} is equal by convention to 1000

3.33 rural area: Area, which has a low density of local metallic structures in direct electric contact with the soil.

3.34 urban area: Area, which contains a high density of local metallic structures in direct electric contact with the soil, such as water pipes, cables with bare metal sheaths, earth wires of bare copper, tracks of tramways or underground or overground traction systems and earth-terminations and structures of buildings, masts and foundations.

3.35 interference frame: The complete interference scenario pertaining to a single plant, to be examined as a whole.

The interference frame of an induced plant contains the induced plant itself and all the plants inducing it. The interference frame of an inducing plant contains the inducing plant itself and all the plants induced by it.

3.36 interference result: Electric quantity able to describe the amount of the interference. An interference result can be evaluated through calculations and measurements.

3.37 interference effect: Consequence of interference on people touching the induced plant and on the induced plant itself or the connected equipment.

3.38 immunity: The ability of a device, equipment or system to perform without degradation in the presence of a disturbance, see clause 3.21.

3.39 resistibility: The ability of a device, equipment or system to withstand, without damage, in the presence of an electromagnetic phenomena up to certain, specified extent, and in accordance with a specified criterion.

3.40 management voltage: General name encompassing all the induced voltages to be used to evaluate if an interference situation is acceptable, i.e.:

- the limit values related to danger to people working on the telecommunication plant;
- the limit value related to noise;
- the minimum resistibility voltage level of the equipment connected to the telecommunication plant;
- the minimum insulation withstand voltage level of the telecommunication plant;
- the minimum immunity voltage level of the equipment connected to the telecommunication plant.

3.41 typical situation: The typical situation of the e.m. interference due to power systems is characterized by the following aspects:

- the work on telecommunication plant is carried out by trained and experienced personnel;
- the working conditions are such that only current paths hand-to-hand and hand-to-feet are to be considered;
- the admissible current is the one given in [IEC/TS 60479-1] (Figure 20, curve c_2).

3.42 severe situation: The case where the aspects characterizing the typical situation of the e.m. interference due to power systems are not applicable is referred to as a severe situation. A severe situation is characterized by the following aspects:

- the working conditions are such that current paths hand-to-hand, hand-to-feet, hand-to-chest and hand-to-hip are to be considered;
- the source impedance value is assumed to be zero;
- the admissible current is the one given in [IEC/TS 60479-1] (Figure 20, curve c_1).

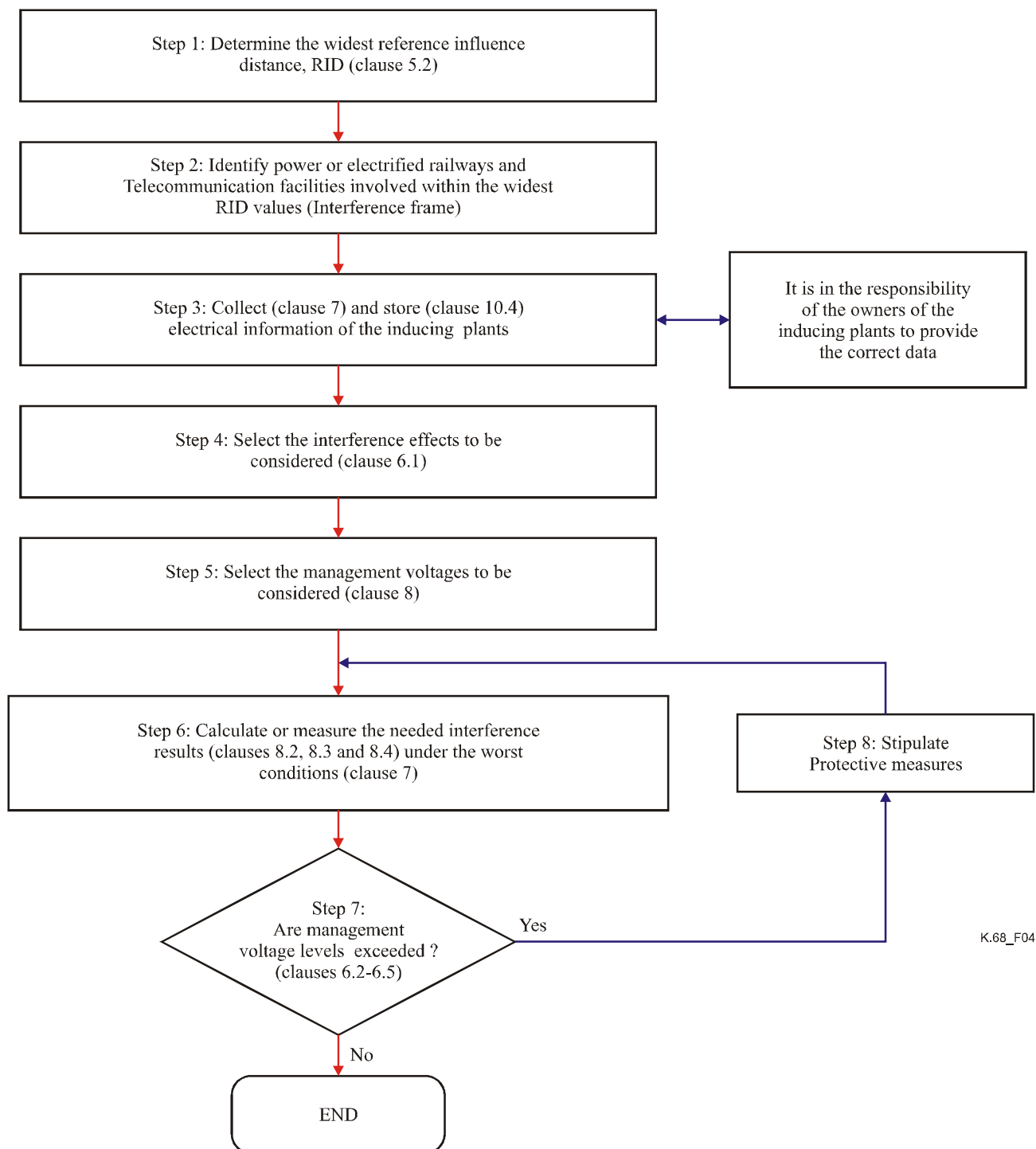
4 Procedure for evaluating the e.m. interference

4.1 General

In order to evaluate if an interference situation is acceptable, a designer must perform an activity which could be subdivided into various steps (see Figure 4).

The following clauses aim to recommend on how to proceed¹.

¹ The procedure described is referring to the case of a new telecommunication plant to be designed, facing existing power plants: of course, the reverse case can also happen. In the case of designing a new inducing plant, the procedure is similar with some "obvious" differences.



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Figure 4 – Flow chart summarizing the procedure for evaluating the e.m. interference

4.2 Interference frame

According to the widest reference distance (given in clause 5.2), a census has to be performed of the possible inducing plants. This can be done by surveys and/or by contacting the owners of such plants to know the layouts of the latter. Then, according to the type of each plant, the relevant coupling types have to be selected (see clause 5.1), and the actual reference influence distances have to be determined (see clause 5.2) for each coupling type and for each possible inducing plant. Depending on the actual reference influence distances, some inducing plants can be ignored. At the end of this step the interference frame for the induced plant is known.

4.3 Collection of electrical information of inducing plants

When an inducing plant is planned to be built or altered, the owner must inform the owners of effected plants. Such information must include the electrical data needed to describe the reference interference conditions (clause 7).

It is the responsibility of the owners of the inducing plants to provide the correct data: thus, it is important to have a record of it (see clause 10.4).

4.4 Evaluation of the interference results and compliance with the management voltages

4.4.1 Background principles

As a function of the type of induced plant and, in connection with all the inducing plants of the interference frame, the designer must:

- select the interference effect(s) to be considered, according to clause 6.1;
- assess the interference result(s) for each effect selected in the previous step, according to clause 6.1;
- perform calculations or measurements or a suitable combination of both, in order to evaluate the needed interference results, according to clauses 8.2, 8.3 and 8.4. The interference situations to be examined (worst case interference) have to be selected according to clause 7.

4.4.2 First evaluation

By calculations or by measurements or by a suitable combination of both, compliance with the management voltages (clauses 6.2, 6.3, 6.4 and 6.5) shall be evaluated for the induced plant in its basic design configuration (see clause 8.1).

If the interference situation is acceptable, no more design activities are necessary.

If the interference situation is unacceptable, mitigation measures shall be applied.

4.4.3 Mitigation measures design: Subsequent evaluations

The designer has to select possible mitigation measures, and to make evaluations, by calculations or by measurements or by a suitable combination of both, to find the ones which are best suited for the induced plant.

Which measures shall be taken and whether the measures shall be taken at the inducing or the induced system will depend on the type and extent of the interference, on the cost of the mitigation measures, and whether systems already exist or are in the design phase. As in every design activity, the best solution is a good compromise between technical and economical needs.

The designer must manage this activity very carefully.

The designer must take into account that mitigation measures able to reduce the induction results in a part of the induced plant (e.g., an earth connection at one end of the plant) can produce an increase in other parts of the plant (e.g., on the opposite end of the plant); thus, it is important to consider various induction configurations.

The designer must also take into account that a mitigation measure able to solve an unacceptable interference situation produced by a given inducing plant can, at the same time, transform an acceptable interference situation produced by another inducing plant into an unacceptable one. This means that all the plants of the interference frame must be adequately considered.

NOTE – In general, except for conductive coupling at substations, the situation is expected to be acceptable if the induced line is a conductor in a cable with earthed metallic sheath or screen and is fitted with lightning protectors at both ends, and special precautions are used to prevent an inadmissible current flow through the body.

5 Interference situations to be examined

5.1 Coupling types to be considered

5.1.1 Planning stage

Tables 1, 2 and 3 define the coupling types requiring examination (calculation or measurement) before bringing new plant into service.

Table 1 relates to single earth fault conditions and allows for the fact that fault current values associated with isolated and resonant earthed systems are low.

Conductive coupling is only considered in areas where telecommunication systems enter an EPR (earth potential rise) zone of a power earthing grid.

Table 1 – Coupling types to be considered for power plants under various earth fault conditions – Planning stage

Power plant type		Telecommunication plant type		
		Overhead cable		Underground cable
		Without metal sheath	With metal sheath connected to earth	
2- and 3-phase a.c. overhead electric power system	neutral earthed directly or through small impedance	inductive conductive	inductive conductive	inductive conductive
	neutral isolated or resonant earthed	none	none	none
2- and 3-phase a.c. electric power cable system	neutral earthed directly or through small impedance	inductive conductive	inductive conductive	inductive conductive
	neutral not directly earthed	none	none	none
d.c. electric power system		none	none	none
a.c. electrified traction system		inductive conductive	inductive conductive	inductive conductive
d.c. electrified traction system		none	none	none

Table 2 – Coupling types to be considered for power plants under normal operation, which may cause danger to people or damage to a telecommunication plant – Planning stage

Power plant type		Telecommunication plant type		
		Overhead cable		Underground cable
		Without metal sheath	With metal sheath connected to earth	
3-phase a.c. overhead electric power system	all types of neutral earthing	inductive capacitive	inductive	inductive
3-phase a.c. electric power cable system	all types of neutral earthing	none	none	none
d.c. electric power system		none	none	none
a.c. electrified traction system		inductive	inductive conductive	inductive conductive
d.c. electrified traction system		none	conductive	conductive

Table 3 – Coupling types to be considered for power plants under normal operation which may cause disturbance to a telecommunication plant – Planning stage

Power plant type		Telecommunication plant type		
		Overhead cable		Underground cable
		Without metal sheath	With metal sheath connected to earth	
3-phase a.c. overhead electric power system	all types of neutral earthing	inductive	inductive	inductive
3-phase a.c. electric power cable system	all types of neutral earthing	none	none	none
d.c. electric power system		none	none	none
a.c. electrified traction system		inductive	inductive conductive	inductive conductive
d.c. electrified traction system		none	none	none

5.1.2 Operation stage

All coupling types, other than those found in Tables 1, 2 and 3, do not usually result in danger, damage or disturbance, thus calculations or measurements are only required if effects of interference appear.

5.2 Reference influence distance

5.2.1 General

Power plants located at a distance less than or equal to the reference influence distance (RID) from a given telecommunication plant shall be considered as inducing plants for this telecommunication plant. This allows for establishing the interference frame for the induced telecommunication plant.

Telecommunication plants located at a distance less than or equal to the RID from a given power plant shall be considered as induced plants for this power plant. This allows for establishing the interference frame for the inducing power plant.

The objective of RID is to limit the number of inducing plants to be considered and for which the inducing current/voltages values are necessary.

This Recommendation suggests the values of RID given in the following clauses: they have been evaluated with the method presented in Annex A and the assumptions described in Appendix II under the worst conditions represented by the fault conditions for the electric power lines and normal conditions for electric traction lines (the values reported in the tables refer to the worst case, i.e., larger RID values); however, different values may be defined in each country, e.g., by the national committee or authority, or should be agreed by the involved parties, using the method given in Annex A and assuming different values of the involved parameters with respect to the values shown in clause II.2, in order to better meet the national conditions. A range of values for these parameters is described in clause II.1.

The RID has the practical goal of allowing one to know which are the plants whose electrical data have to be asked for from the power/traction/telecom administration or network operator. However, the RID concept does not eliminate the responsibility of the concerned parties on the interference which could occur at distances greater than RID values.

RID should be measured from the projection to earth of the centre of the power line.

5.2.2 Inductive coupling

5.2.2.1 Fault conditions

5.2.2.1.1 a.c. electric power line

The RID values reported in Table 4 for typical situations and Table 5 for severe situations should be applied for $f = 50/60$ Hz.

These tables give the RID values for unshielded short (e.g., access network) or long telecommunication lines as a function of the equivalent soil resistivity, for overhead and underground a.c. electric power lines having directly earthed neutrals in both rural and urban area.

Table 4 – RID values for a.c. power systems at 50/60 Hz in typical situations

Length of the telecommunication system	Equivalent soil resistivity [$\Omega \cdot m$]	RID [m]			
		Power system/environment			
		Overhead		Underground	
		Rural	Urban	Rural	Urban
Short line	50	550	70	(Note)	(Note)
	500	1700	100	(Note)	
	5000	5400	100	300	
Long line	50	1200	500	300	20
	500	3700	1200	1000	
	5000	12000	2400	3100	
NOTE – No interference.					

Table 5 – RID values for a.c. power systems at 50/60 Hz in severe situations

Length of the telecommunication system	Equivalent soil resistivity [$\Omega \cdot m$]	RID [m]			
		Power system/environment			
		Overhead		Underground	
		Rural	Urban	Rural	Urban
Short line	50	1000	400	250	(Note)
	500	3300	800	750	
	5000	10000	1450	2400	
Long line	50	1800	1050	750	200
	500	5800	2600	2400	400
	5000	18000	6500	7500	600
NOTE – No interference.					

The a.c. electric power line, having no directly earthed neutral in general, does not cause interference on telecommunication lines in typical situations (interference can only occur in exceptional cases, see clause II.1); in severe situations, only a.c. electric overhead power lines in rural areas can cause interference on long telecommunication lines. In this case, the following RID values should be applied:

- 30 m for $\Omega = 50 \text{ }\mu\text{m}$;
- 100 m for $\Omega = 500 \text{ }\mu\text{m}$;
- 300 m for $\Omega = 5000 \text{ }\mu\text{m}$.

The RID values reported in Table 6 for both typical and severe situations should be applied for the a.c. electric two-phase power plants at the $f = 16\frac{2}{3} \text{ Hz}$.

Table 6 gives the RID values for unshielded short (e.g., access network) or long telecommunication lines as a function of the equivalent soil resistivity for overhead a.c. lines in rural areas.

NOTE 1 – An underground power line is assumed to be a shielded line. If the shield with an insulated plastic covering is connected to earth at one end point only, the underground line should be considered as an overhead line.

NOTE 2 – An a.c. electric power line is an "overhead" line in rural areas whereas in urban areas only underground lines are installed.

Table 6 – RID values for a.c. electric two-phase a.c power systems at $16\frac{2}{3} \text{ Hz}$ in both typical and severe situations

Power system/environment	Equivalent soil resistivity [$\Omega \cdot m$]	RID [m]			
		Telecommunication system			
		Typical situation		Severe situation	
		Short line	Long line	Short line	Long line
Overhead/rural	50	100	700	800	1800
	500	300	2200	2500	5800
	5000	1000	7000	8000	18000