Coordination of Power and Metal Pipelines Using Risk Based Safety Principles

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Introduction

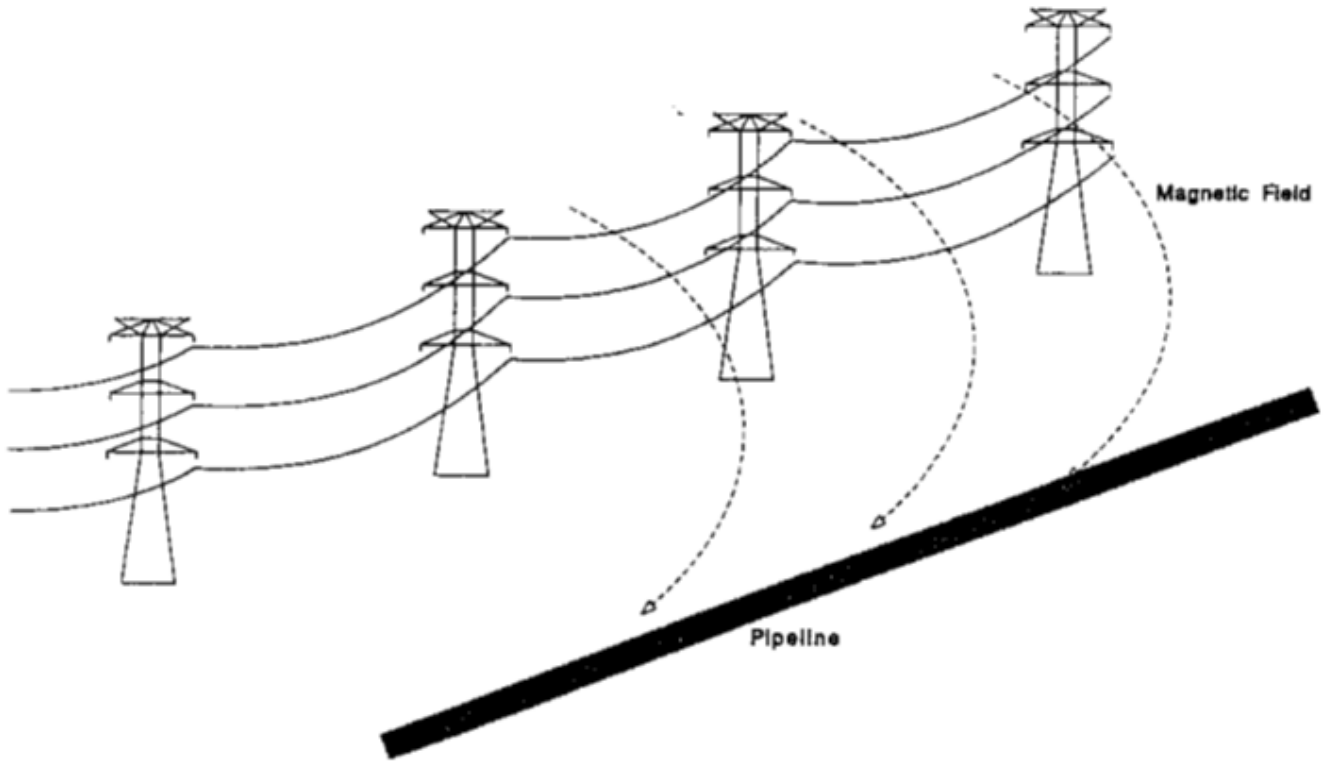
- Background to Coordination Requirements
  - Telecommunication interference method
  - NACE (1977) culminating in RP0177:2000
  - EPRI Project 742-1 (1978) initiated by AGA
  - AS/NZS4853:2000 (simplified risk-based criteria)
  - AS/NZS4853:2012 (EEA/ENA risk-based criteria)

Introduction

- Purpose of this presentation
  - Highlight key differences between Power & Pipeline risk assessments
  - Summarise work pipeline utilities have being doing to comply with new requirements
  - Inform power engineers carrying out coordination works on pipeline assets

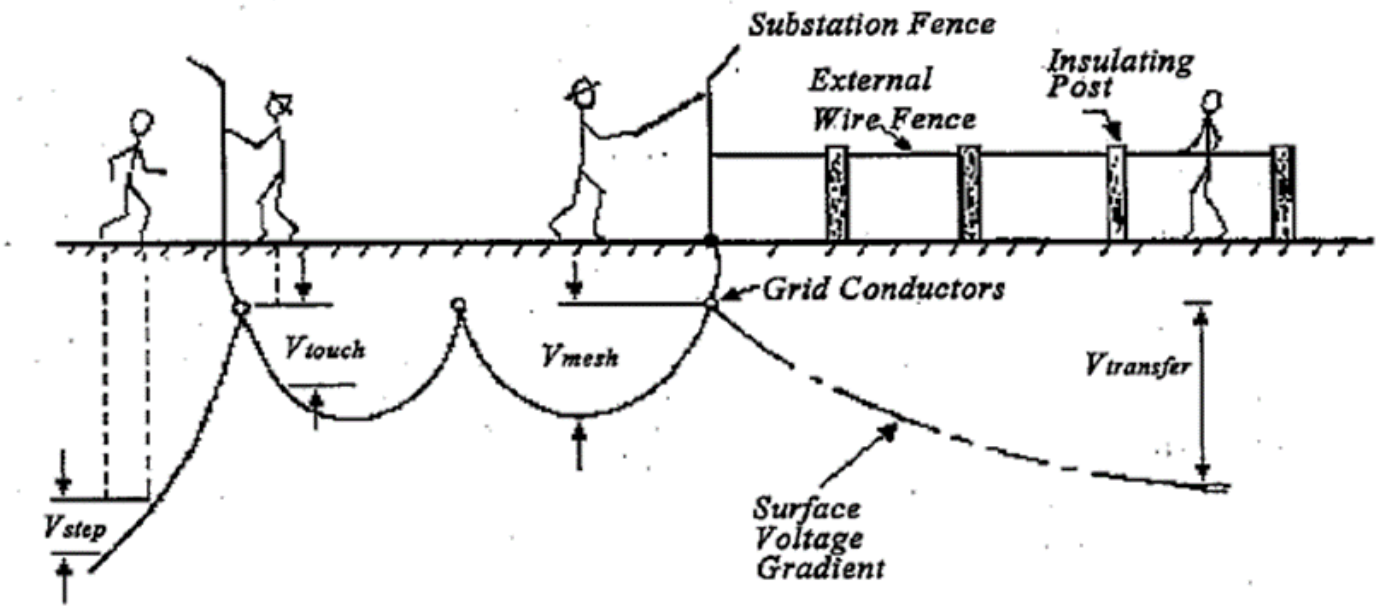
Introduction

- Low Frequency Induction



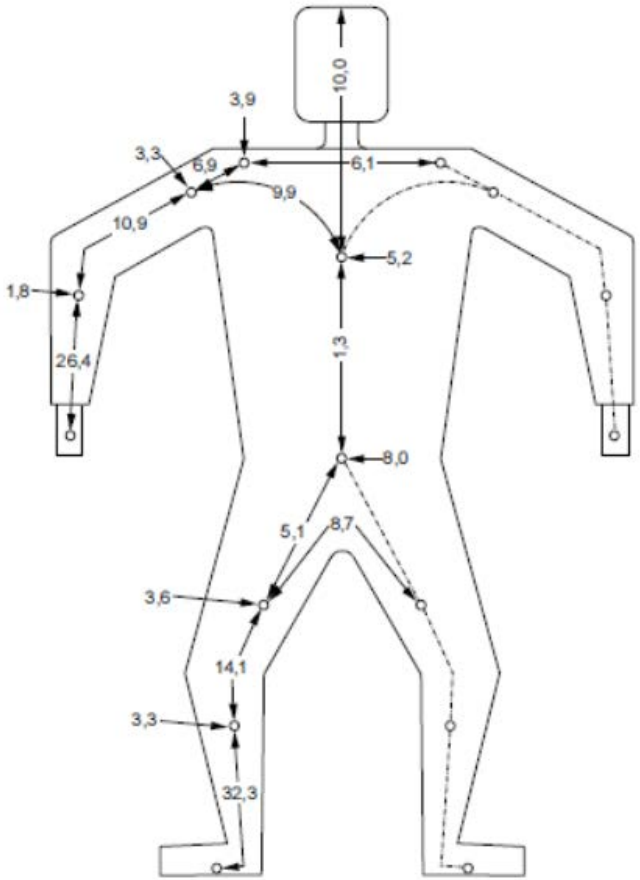
Introduction

- Earth Potential Rise



Introduction

- Touch and Step Voltage Hazards



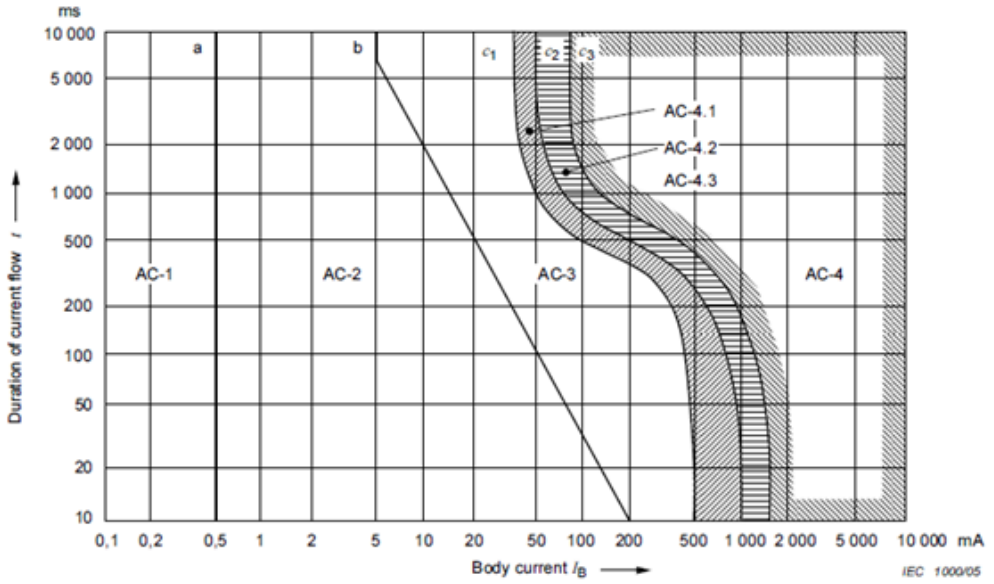


Table 1 – Total body impedances Z_T for a current path hand to hand a.c. 50/60 Hz, for large surface areas of contact in dry conditions

Touch voltage V	Values for the total body impedances Z_T (Ω) that are not exceeded for		
	5 % of the population	50 % of the population	95 % of the population
25	1 750	3 250	6 100
50	1 375	2 500	4 600
75	1 125	2 000	3 600
100	990	1 725	3 125
125	900	1 550	2 675
150	850	1 400	2 350
175	825	1 325	2 175
200	800	1 275	2 050
225	775	1 225	1 900
400	700	950	1 275
500	625	850	1 150
700	575	775	1 050
1 000	575	775	1 050
Asymptotic value = internal impedance	575	775	1 050

Introduction

- Risk Based Analysis

$$P = E_f \times F_f$$

$$E_r = \frac{\text{Total duration of exposure per year (in hours)}}{\text{Number of hours in a year}}$$

F_f = Average number of hazardous EPR events per year

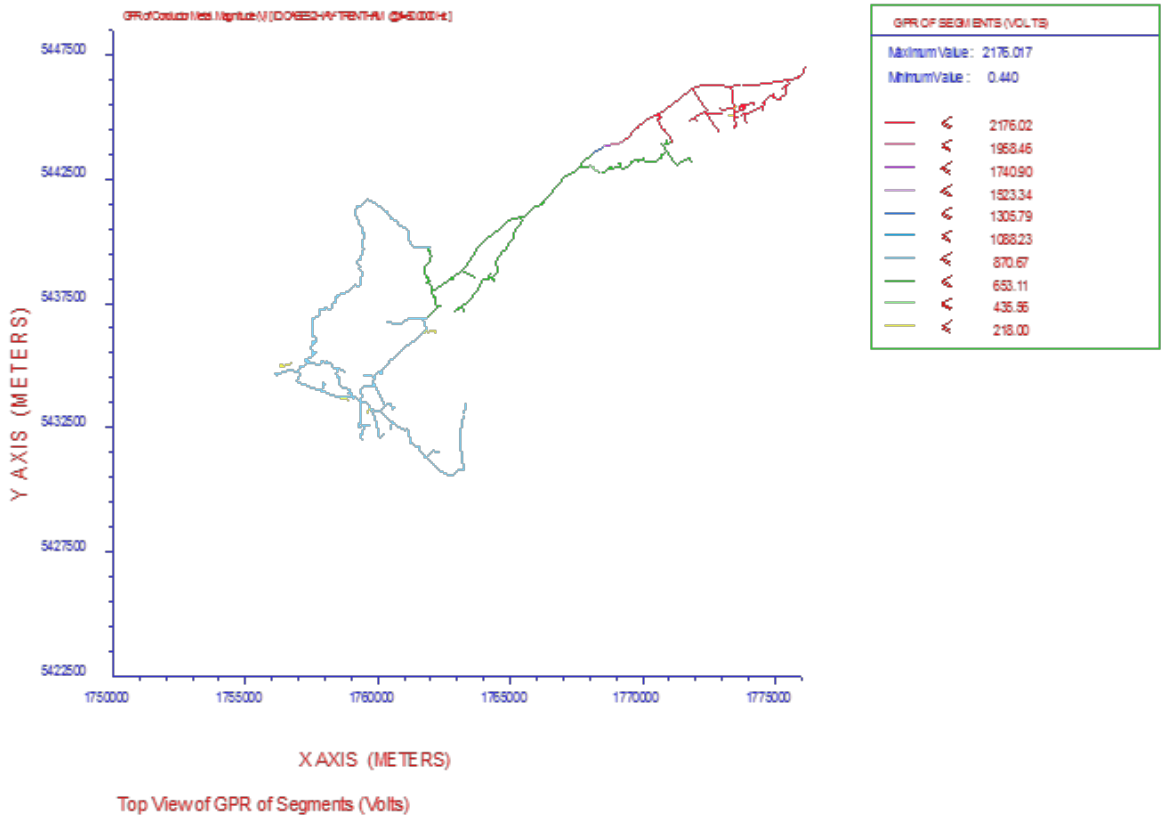
Introduction

- Risk Based Criteria

Equivalent probability (per annum)	Risk classification for individual death	Resulting implication for hazard mitigation
$> 10^{-4}$	High	Intolerable Must prevent occurrence regardless of costs
$10^{-4} – 10^{-6}$	Intermediate	ALARP for Intermediate Risk Must minimise occurrence unless risk reduction is impractical and costs are grossly disproportionate to safety gained
$<10^{-6}$	Low	ALARP for Low Risk Minimise occurrence if reasonably practical and cost of reduction is reasonable given project costs

Power Industry Risk Assessment

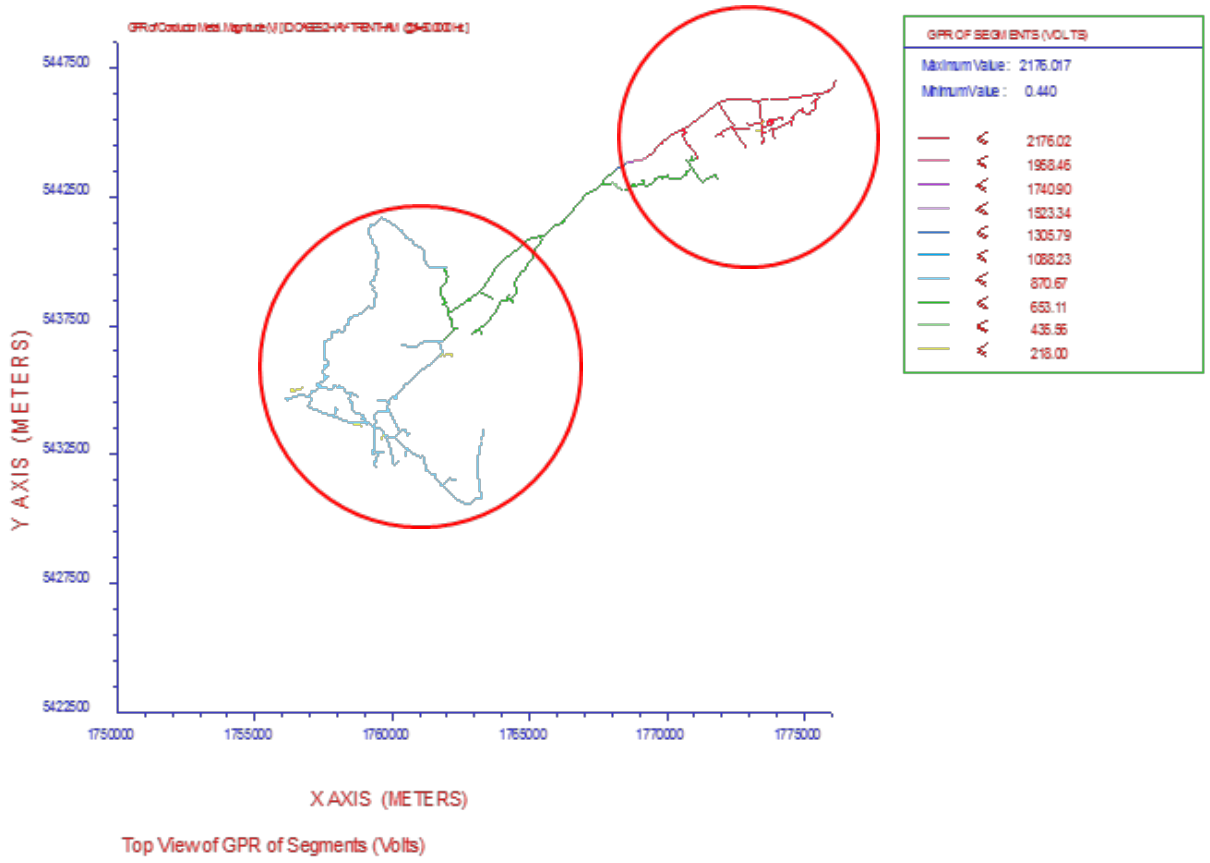
Pipeline Industry Risk Assessment



Top View of GPR of Segments (Volts)

- Well insulated unearthed metal pipelines
- Exposure to many overhead and underground transmission and distribution circuits
- An earth fault on a power circuit can cause a dangerous impressed pipeline voltage many tens of kilometres away
- Treating risk at one site can create new risks at other sites
- Pipeline staff not as well trained or equipped for these hazards

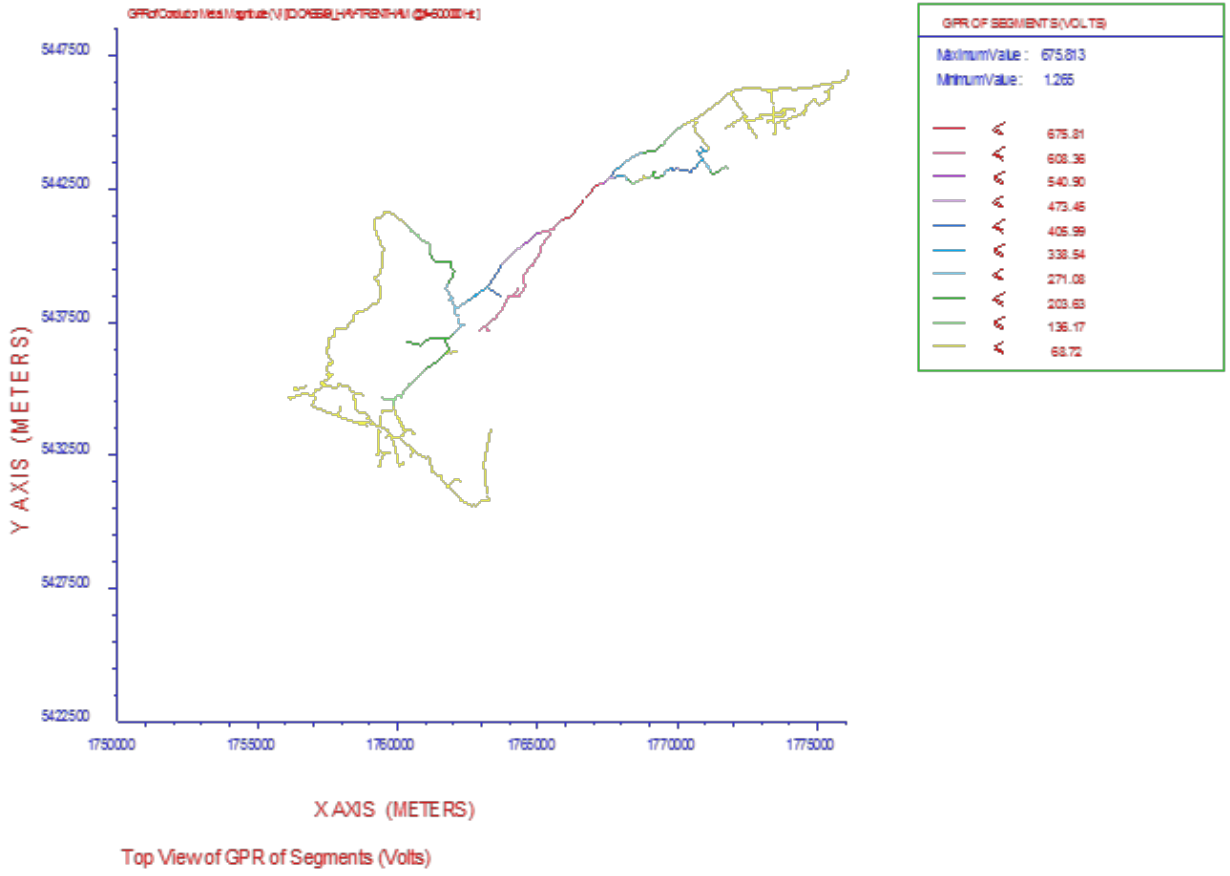
Pipeline Industry Risk Assessment



Top View of GPR of Segments (Volts)

- Each pipeline access scenario potentially has multiple risk components associated with multiple circuits
- Staff are exposed to multiple risk components on multiple pipelines during a year
- Risk assessment must consider all relevant risk components
- Changes to a single powerline may alter only some of the risk components but not the total risk to staff

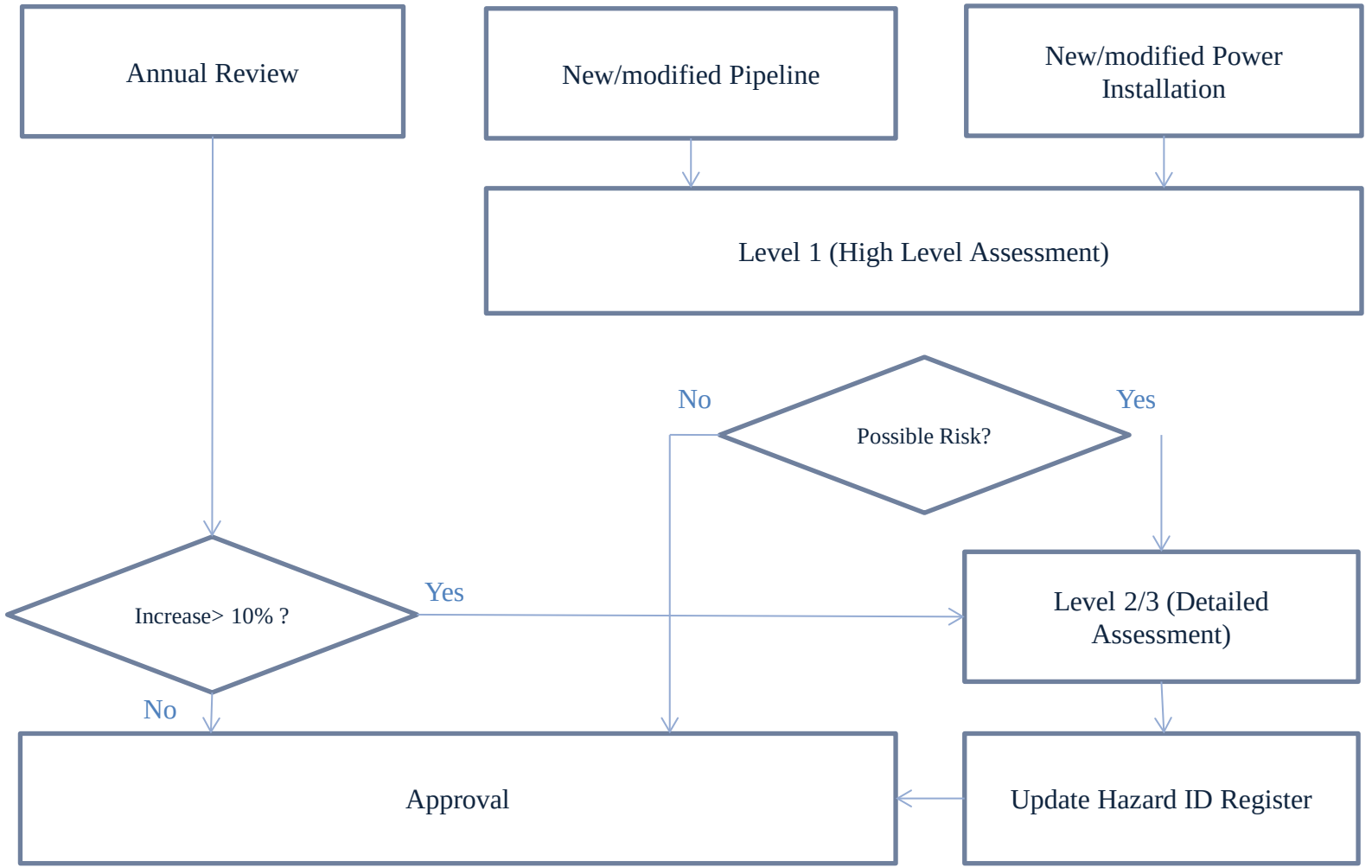
Pipeline Industry Risk Treatment



Top View of GPR of Segments (Volts)

- Surge protection across FIKs
- Anode beds
- Pipeline earth electrodes with PCRs
- Equipotential bonding
- Asphalt surface treatment
- Insulating clothing and tools

Electrical Hazard Management Plan



Conclusions

- There are key differences between risk assessments in power and pipeline industries
- The initial (Level 1) assessment is a desktop assessment only
- Basic voltage limit assessment (inputs to detailed calculations required from pipeline utility)
- Personal Safety Assessment – power utility to provide key data to pipeline utility so that they can advise on appropriate risk treatments

Questions

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