

Compliant Considerations in relation to the 1989 NHMRC Interim Guidelines and the ARPANSA Draft ELF Standard

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OUTLINE

Introduction

- 50 Hz Electric Fields
- 50 Hz Magnetic Fields

1989 INIRC/NHMRC 50/60Hz Interim Guidelines

ARPANSA Draft ELF Standard (0 – 3000 Hz)

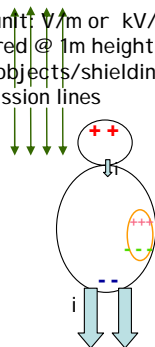
Compliant Considerations

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50 Hz ELECTRIC FIELDS - General



- voltage & distance, unit: V/m or kV/m
- unperturbed, measured @ 1m height
- terminate (stop) on objects/shielding
- main source: transmission lines



Protective considerations:

- **Capacitive-coupling:**
(charges induced on body/objects)
 - + first contact: transient discharge → discharge shocks
 - + steady state: current, in-situ E field
 - electrostimulation (synapses, PN..)

Protective metrics:

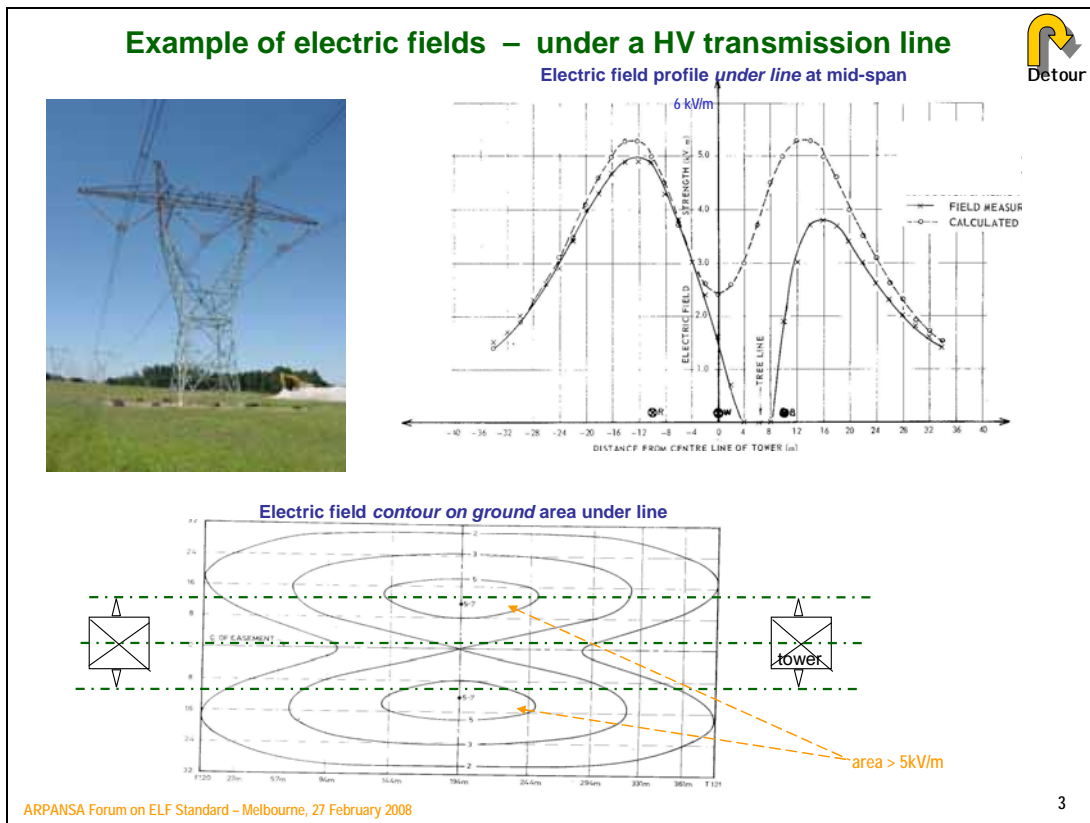
- Environmental E field (unperturbed fields)
- Induced internal E field as Basic Restrictions

examples of electrical / indirect effects:

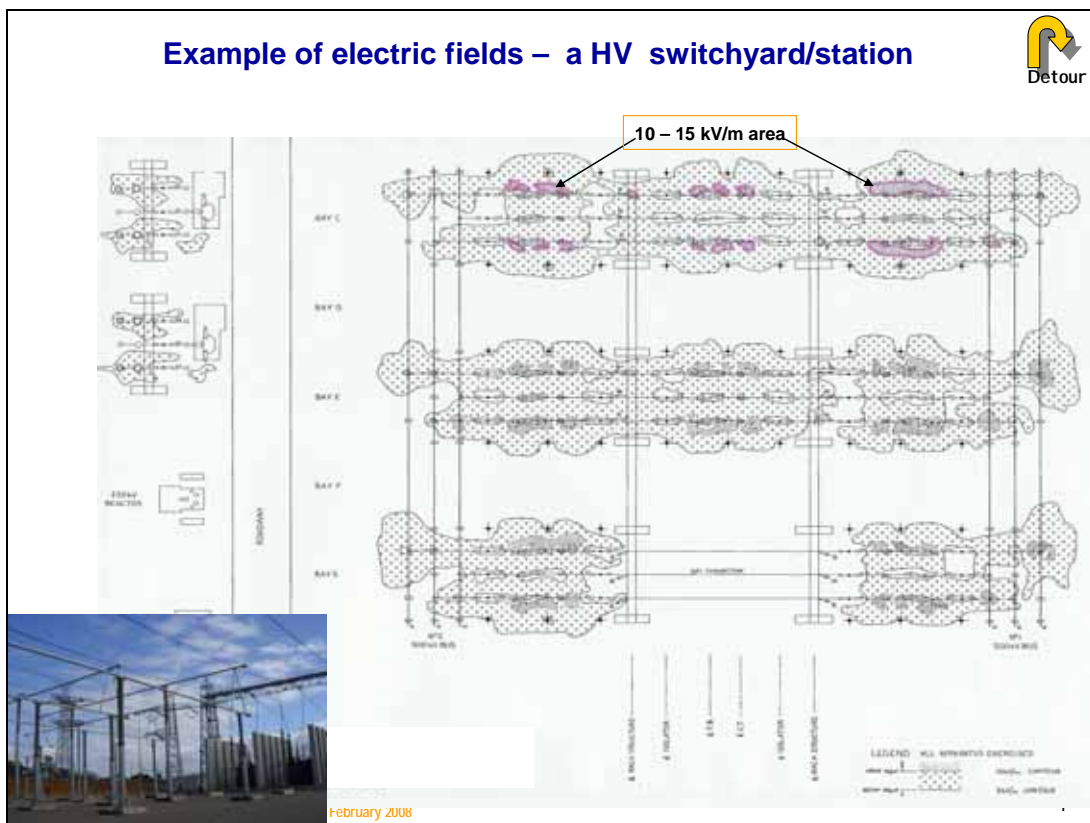
- discharges from/to body-objects:
 - roof, fence, clothes line, wet clothes, metallic objects, trellis
 - vehicles, equipment, tools, structures/objects in occupational setting.
 - land use compatibility (road, farms, parking/commercial areas, sport/play grounds, backyards ...)
- skin sensation: vibration of hairs.
- sparks: fire risk, fuel ignition, RF interference; corona: audible & RF noises

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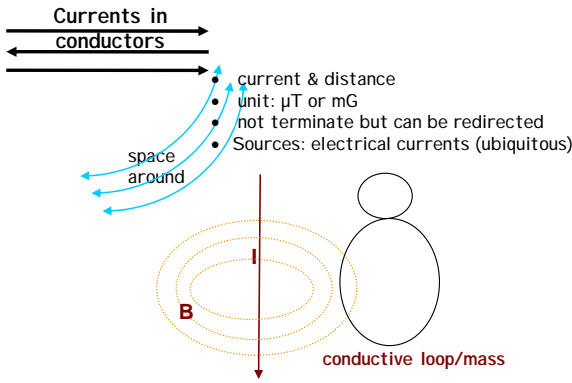
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50Hz MAGNETIC FIELDS - General



Currents in conductors



current & distance
 unit: μT or mG
 not terminate but can be redirected
 Sources: electrical currents (ubiquitous)


space around

B

conductive loop/mass

• Protective considerations:

- Induced voltage, E field, I or J for electrostimulation of synapses or peripheral nerves



• Protective metrics:

- Basic Restrictions = internal E_{int} (mV/m)
- Reference Levels: external uniform magnetic field over relevant part of body.


Other electrical effects:

- **Induced voltages:** pipe, wire, fence, rail...electronic implants.
- **EMC:** interference with electronic implants, equipment e.g CRT-based monitors ..., audible hums


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Example of Magnetic Fields – a HV Switchyard



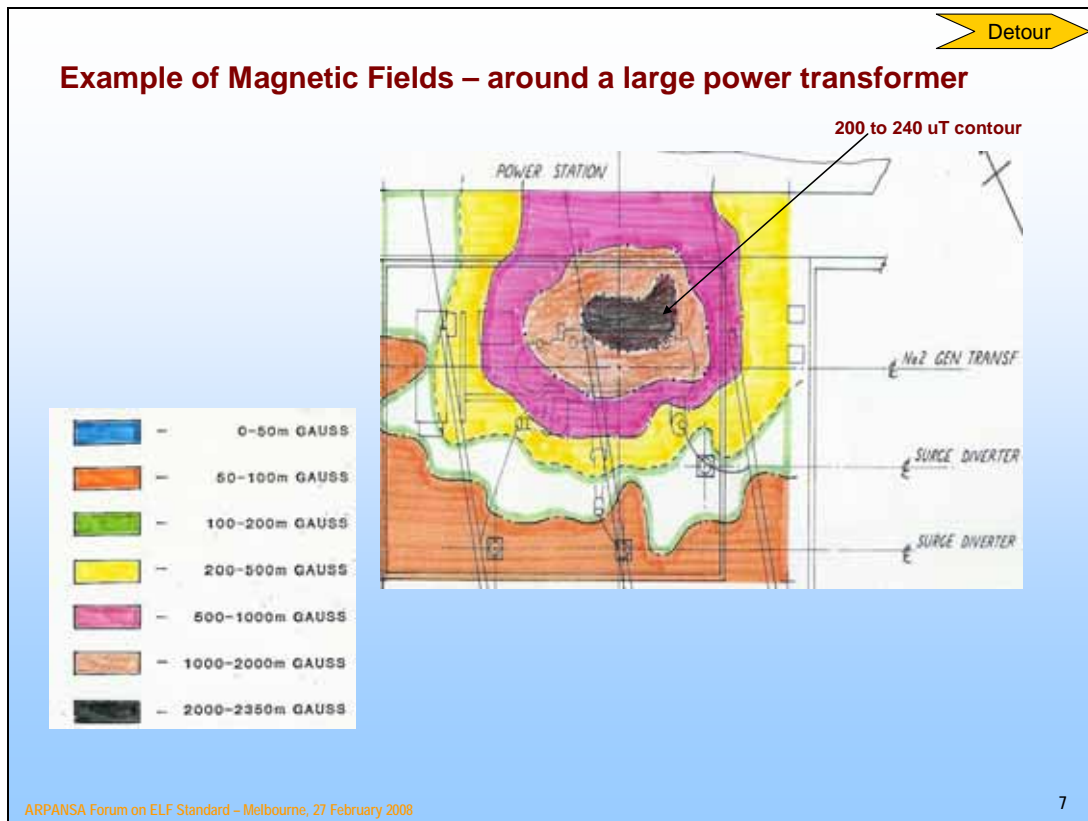
10 to 20 μT contour



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Detour


More examples of elevated 50 Hz magnetic field sources (closed proximity of high current cables & apparatus)

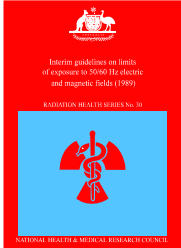
Next to heavy current carrying cables/apparatus:

- underground cables in pits, substations, cable risers
- busbars & equipment in generation facilities
- electrolysis, electro-induction industrial plant
- air-core coils/reactors, conductors next to live-line working
- large motors, transformers,
- ...

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| Human exposure & electromagnetic safety standards/guidelines –  | | |
|--|---|---|
| Australia | | Notes |
| 1970's | Utility electric field practices/guidelines | - E field only, discharge shock considerations. - short durations (minutes/hours, not TWA) for elevated E field locations. |
| 1989 | INIRC of IRPA NHMRC (adopted): "Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields (1989)" | - simple 50/60 Hz, reference-level limits only - reference to measurement standard (IEC, IEEE (1987)) - short durations (minutes-hours) for elevated fields - neurons/excitable tissues response in order of second / less. - superceded by ICNIRP 1998 (INIRC became ICNIRP) |
| present | ARPANSA Draft ELF Standard | - 0 to 3000 Hz. - wider electrophysiology basis, various types of limits, induced E based. - 2-tier: GP and Occupational + sub-tiers. - reference to several IEC, IEEE, CIGRE documentation for field measurement/calculation ... |
| Others | | Notes |
| 1998 | ICNIRP "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)" | - large spectrum, discharge shock & electrostimulation basis, various types of limits, J based - adopted in various formats by a number of countries - accompanied by several IEC/Cenelec standards for field measurement/calculation, compliant evaluation |
| 2002 | IEEE/CES Standard C95.6 "Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0 to 3 kHz" | - discharge shocks & electrostimulation basis, various types of limits, induced E based - 2-tier: GP and "controlled environment" - reference to measurement Std IEEE1460 (1996) & draft standard (IEEE C95.3) on measurement computation techniques 0-100 KHz is in progress. |
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| 1989 NHMRC Interim guidelines on limits of exposure to 50/60Hz electric and magnetic fields | | |
|--|--------------------------------------|--|
| <ul style="list-style-type: none"> • 50/60 Hz only, interim nature. • higher limits given for short occasional exposure (few hours) and incidental exposure (few minutes). • highlight importance of internally induced fields but limits focus on environmental or ambient fields. • can compare to 50Hz "Reference Levels" of recent standards/guidelines. | | |
|  | | |
| General Public / Exposure Condition | Electric Field (kV/m) | Magnetic Field (uT) |
| Up to 24-hour/day | 5 (in area of 5 or less) | 100 (in area of 100 or less) |
| Few hours/day | 10 (in area of >5 to 10) | 1000 (in area of >100 to 1000) |
| Occupational / Exposure Condition | Electric Field (kV/m) | 50 Hz Magnetic Field (uT) |
| Whole working day | 10 (in area of 10 or less) | 500 (in area of 500 or less) |
| Short-term (up to two / few hours) | 30 (in area of >10 to 30) | 5000 (in area of >500 to 5000) |
| Limbs | - | 25000 |
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Comparison: Electric Field Reference Levels

| Population / Nature of exposure | NHMRC Interim Guidelines (1989) Electric Field (kV/m) | ARPANSA Draft ELF Standard Electric Field (kV/m) |
|--|--|--|
| General Public - Living environment, HV transmission-line's easements | 5 (>0 to 5) (up to 24-hour/day) | 5 (>0 to 5) |
| General Public - Higher field locations, some areas on easements | 10 (>5 to 10) (short term) - few hours/day - require known hi-field locations and process to monitor durations of activities. | 10 (>5 to 10) (controlled activity/circumstance) - no hour limit, not require monitoring of time spent in high-field locations. - require signage (e.g. for high field locations & relevant information) |
| Occupational - High-voltage installations/switch-yards | 10 (>0 to 10) (whole working day) | 10 (>0 to 10) |
| Occupational - Hi-field locations - Some pocket areas in HV switch-yards (10-20 kV/m) | 30 (>10 to 30) (short term) - up to few hours per working day (8hrs decreases to 2.7 hours) - require known fields & monitoring of time spent in high-field locations | 20 (>10 to 20) (controlled activity/circumstance) - no hour limit, not require monitoring of time spent in high-field locations. - require signage (e.g. for high field locations & relevant information ...) |

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Comparison: Magnetic Field Reference Levels General Public

| Population / Nature of exposure | 1989 NHMRC Interim Guidelines Magnetic flux density (uT) | ARPANSA ELF Draft Standard Magnetic flux density (uT) |
|---|---|--|
| General Public - living environments - high-field locations | 100 (>0 to 100: up to 24-hour/day) | 300 |
| General Public -higher field locations -closer proximity of hi-current sources | 1000 (few hours/day) 100 to 300 - few hours/day - require known field locations and durations of activities >300 to 1000 - few hours/day - require known field locations and durations of activities | 100 to 300 - within reference level - not require duration monitoring as per NHMRC >300 to 1000 - above reference level - require compliant evaluation to BR or other measures |


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Comparison: Magnetic Field Reference Levels Occupational

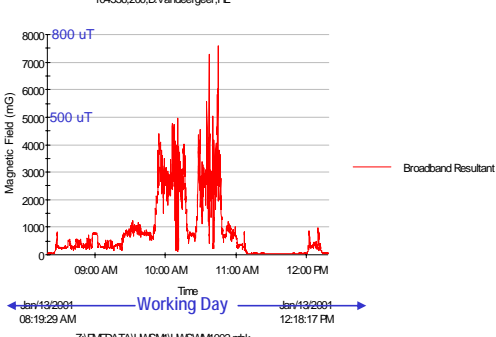
| Population / Nature of exposure | NHMRC Interim Guidelines (1989) Magnetic flux density (uT) | ARPANSA ELF Draft Standard Magnetic flux density (uT) |
|--|--|---|
| Occupational - close to high-current sources / high-field locations - close to hi-magnetic field apparatus | 500 | 1500 (head) 1800 (torso) |
| Occupational - close to higher-current sources / higher-field locations - closer to hi-magnetic field apparatus | 5000 (>500 to 5000: 2hrs/day) >500 to 1500: - up to 2 hours/day -require known field contours of the installation & monitoring of time spent in high-field locations >1500 to 5000: - up to 2 hours/day -require known field contours of the installation & monitoring of time spent in high-field locations | >500 to 1500 (head) - within reference level - not require duration monitoring as per NHMRC >1500 to 5000 - above reference level - require compliant evaluation to BR or other measures |
| Limbs | 25000 | 9000* * under ongoing development/consideration |

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An example: live-live working on transmission line and compliant considerations



104536,200,D.Vandenberg,HE



Time: Working Day (Jan/13/2001 08:19:29 AM to Jan/13/2001 12:18:17 PM)

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Case 1: Highest torso MDF = 800 uT & exposure time = 1 hour over working day
 Case 2: Highest torso MDF = 2000 uT & exposure time = 1 hour over working day

| Nature of exposure | NHMRC Interim Guidelines | ARPANSA ELF Draft Standard |
|--------------------|---|--|
| Case 1 | In area: > 500 to 5000uT Control of duration for 2 hours/day | No special requirement |
| Case 2 | In area: > 500 to 5000uT Control of duration for 2 hours/day | >1800 (torso) - above reference level - require compliant evaluation to BR or other measures |

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Thank You !