IMPLEMENTATION OF LIVE WORKING ON LOW VOLTAGE IN SLOVENIA Arc Flash Risk Assessment

Dr. Viktor Lovrenčić DVS, Slovenia







EUROPEAN STANDARD EN 50110-1:2013

Operation of electrical installations – Part 1: General requirements

Working procedures are divided into three different procedures: dead working, **live working**, working in the vicinity of live parts.

All these procedures are based on the use of protective measures against electric shock and/or the effects of short-circuits and arcing.





EUROPEAN STANDARD EN 50110-1:2013 (point 3.4.4)

live working

all work in which a worker deliberately makes contact with live parts or reaches into the live working zone with either parts of his or her body or with tools, equipment or devices being handled Note: At low voltage, live working is carried out by the worker, when making contact with bare live parts. At high voltage, live working is carried out by the worker, when entering the live working zone, regardless of whether contact is made with bare live parts or not. [SOURCE: IEC 60050-651:1999, IEV 651-01-01 modified]





EUROPEAN STANDARD EN 50110-1:2013

3.6.1 extra-low voltage (ELV) normally not exceeding 50 V alternating current (a.c.) or 120 V ripple free direct current (d.c.) whether between conductors or to earth Note: This includes SELV, PELV and FELV (see HD 60364-4-41). [SOURCE: IEC 60050-826:2004, IEV 826-12-30 modified]

3.6.2 low voltage (LV) normally not exceeding 1 000 V a.c. or 1 500 V d.c. [SOURCE: IEC 60050-151:2001, IEV 151-15-03 modified]

3.6.3 high voltage (HV) normally exceeding 1 000 V a.c. or 1 500 V d.c.





DEFINITION of arc flash

An arc flash is an undesired electric discharge that travels through the air between conductors or from a conductor to a ground. The resulting explosion can cause fires and serious harm to equipment and **people**.

The temperature of an arc flash may exceed **10.000 degrees Celsius**, which is capable of vaporizing metal and sending a **blast of plasma and molten metal in all directions with extreme force.**





What is arc flash?

What is Arc Flash?

- Electrical hazard
- Severe health effects on human being
 - Burns
 - Death
- Triggered by
 - Equipment defects
 - Defect of tools
 - Human errors:
 - Lack of distance to live parts
 - Lack of insulating blankets
 - Errors by switch off equipment (5 safety rules)

















Electrical flash burns. Mills, Morton, Page. A Color Atlas of Accidents and Emergencies, 1984







DEFINITION of arc flash

Risk assessment for the occurrence of arc flash that can have very damaging consequences **for personnel and equipment in electrical facilities** is increasingly applicable in advanced countries such as USA, Canada and the EU (**Slovenia - in the promotion phase**).

These countries have regulations and norms to regulate legislative issues and obligations regarding risk assessments as well as the mandatory use of PPE for personnel that may be exposed to such risks.





Arc flash risk assessment **is today a mandatory part of each risk assessment for electrical workplaces** and several recommendations exist in different countries:

(for example national OSHA rules in USA, EN 50110-1 and PPE Directive in Europe).

The Electricity Section of the International Social Safety Association ISSA published guidelines for users to select PPE against the thermal hazards of electric fault arcs ...





Slovenia has EU adopted Directives & has national legislation & use EN/SIST standards and IEC standards **to regulate this field**.

For example **Germany** uses a standard and recommendations:

- DGUV Information 203-077
- GS-ET-29:2011-05 Test Principles





On following questions you/we have to answer:

- 1. Who needs arc rated PPE?
- 2. For which operations and type of work your/our electricians need Arc rated PPE?
- 3. Which type and arc protection level of PPE your/our electricians need?
- 4. How you/we can convert the calculated arc protection level in practical and useful products?





Arc Flash Calculation Methods





Arc Flash Different Calculation Methods

Arc flash risk assessmer

Arc Flash option in EasyPower Arc Flash module

Short Circuit Options			×									
Control Text Output	Customize Arc Flash con	ntrol settings.	0000	RENblad 1710, Arc Flash Calcula	tor - Cale	culation of arc flash	incident energy a	and safe v	vorking d	istance		
One-line Output	Sandard: IEEE 1584	Worst-Case Arc Rash Hazards	1	Fill ion while cells and press "Calculate" - If you change any input y	you need to press '	"Calculate" again to calculate the results."			Ū			
Arc riash hazaro	Use worst case arcing current (<1kV bu	uses only) Max Times (sec)		Input data, electrical equipment V - system voltage. Min 200V - max 15kV	0,4)w	Boundary Energy can	be set at 1,2 califors" ()	a you") for here di			
	and 85 🕹 % of Calc Arcing	kA ✓ <0.25 kV: 0.25 to 1 kV: > 1 kV: kA ✓ 100 100 100		ly- Three Phase Fault. Min 700A - max 106kA G - Conductor Gap. Min 20 mm - max 152 mm	66,662 32	M Calculate	The limit of 1,2 califors" is that a PPE has to a	t which a person is like to cover head, face, re	ly to receive second de ok and hands.	gree harrs.		
	Create Report	Calculate Arc Rash Using: Integrated V		Example in the containing one or protection device) Equipment Type K ₂ - System earthing	Enclosed Grounded							
	Arc Rash Spreadsheet	Display Incident Energy in: J/cm2 V		0 - Distance from arc to person	457	nn	Factor of distance,	arc gap, voltage and	type of equipment	t		
	Arc Rash Threshold	Display Working Distance in: mm		Distance factor, given automatically from the table	1,473				Typcal gap (mm)			
				Eg - Protection Boundary Incident Energy	3,0	1/cm'-> 12 cal/on'		Type of		Factor of		
		Working Distances (Below) Apply to: Enclosed		Input data, PPE (Personal Protective Equipment)			Voltage, less or equal to (kV)	equipment L Cable	ower Upper 13 13	distance, x 2,000		
	kV (cal/cm2)	Default Working Distances (mm)		Arc Rated Jacket and Pants	No	-> Rating approx 12, cal	1	Enclosed	32 32	1,473		
	1 0.1 - 0.3	4 457.2 609.6 914.4		Arc Rated underwear	No	-> Rating approx 8 cal/c		Open air	10 40	2,000		
	2 0.3 - 0.75	4 457.2 609.6 914.4 end An (all datas site)			ADA			Cable	13 13	2,000		
	4 5-15	8 457.2 609.6 914.4			Tert .		5	Enclosed	13 102	0,573		
	5 15 - 36	8 787.4 914.4 1219.2 TERCO	Terres Annual Annual Manager		90	AA		Open air	102 102	2,000		
	6 38 - 46	25 838.2 990.6 1219.2 DOD	Data short circuit current. Aic energy working environme	nt Arc Protection-clara	37	nn		Cable	13 13	2,000		
	8 72.5 - 121	25 990.6 1219.2 1371.6			.7	J/cm ⁴ → 5,2 [cal/cm ⁴]	15	Enclosed	153 153	0,973		
		Fie .	Calculation of an energy at the work place		12	00		Open air	13 153	2,000		
			Peak those between calculator type I provide calculator where the electrois do	terce / a repred in celolator tax i local ceed								
		Section (section (sectin (section (section (section (section (section (section (sect	Calculation types (greater) (adjuster type if your case)	30	sufferty m	etb.						
		Language	Debuk Merce d									
	Defaut	OK										
		a second s										
			Which protective device is present (circul linearies: (circ Vallage Tuse or High Vallage I	lan) ^a								
			Cruid Brailine Birl Aver Sti Tweet Birl Aver Sti Tweet									
			And a second sec									
			The anti-prevalence (TSG) A									
			Trainistator. IF active									
		The description for the Lanceston State on		H ~								
			The and of court of a provide and the second	75 a.A.	Т							
			Searand A more 2	an (b)		User Interface of BSD Arc Calculator						
			Please proceed to exp. "Death doub voting ana".									
			tes (and									
		BED Are Coloridator										
		Version 2.1.3										

RENblad 1710 Arc Flash Calculator

Societies vzv



Arc Flash PPE label



Arc flash risk assessmer

Calculation of arc ener	gy for selection of the pro	rection class of PPE against the thermal has revicinity of electrical systems	x6
	According to DGUV Hon	mation 203-077 : 2012	
The arcenergy was calculat	ted for the following work pla	KK.	
TP Kamenolom Created by: Thomas Jor	dan	on: 4242015 8:49:29 PM	
Rask data:			_
Voltage level.	U = 0.4 kV		
Shot-circuit current			
	6		
Shot, nimult disconnection in	Circuit Breaker		
Calculation Noe	("precise")		
Electrode distance	d = 32 mm		
Working distance	a = 457 mm		
Transmission factor:	k _t = 1.5		
Preliminary result:			
Are shot circuit curwit	Lun = 17.98A		
Fault clearing the	t_ = 93.0 mm		
Arc energy:	Win = 335.2 kJ		
	Testlevel Protection	level for the addictace	
Arc Protection class 1:	165 kJ	554.5 kJ	
Arc Protection class 2:	320%J	1113.9kJ	
Result			
	Required ArcPro	fection Class:	
	Arc Protectic	on Class 1	

Print Report of BSD Arc Calculator







Arc Flash PPE

Arc flash risk assessment









EUROPEAN STANDARD EN 50110-1:2013

Hot stick working – Safe clearance working

Insulating glove working





Bare hand working







LIVE WORKING IN THE

LW has a hundred year tradition in the world.

In 1913 the first carrying out of LW was documented in the USA and in 1933 in Poland and in 1963 in France and ...

in 2006 in Croatia in 2009 in Slovenia:

- from 2009 in nuclear power plant Krško,
- from 2010 in paper mill Vevče
- from 2011 in distribution & transmission
- from 2011 in University Medical Centre Ljubljana ...!





LIVE WORKING IN THE

LW has a hundred year tradition in the world.









LIVE WORKING on LV (e.g. 0,4 kV)



enedis.Fr

Franci

80























LIVE WORKING on HV (> 110 kV)





LIVE WORKING in SLOVENIA











LIVE WORKING & ASSO

LWA: Live Working Association

CIGRE: Conseil International des Grands Réseaux Electriques (Council on Large Electric Systems)

IEEE: Institute of Electrical and Electronics Engineers

CIER: Comisión de Integración Eléctrica Regional

ICOLIM: International Conference on Live Line Maintenance (LWA)





LIVE WORKING quality of

The impact of LW on the quality of electricity can be measured by the satisfaction of customers:

- uninterrupted supply of electricity by distributor

or

- uninterrupted supply of electricity by work on internal electrical installations.





LIVE WORKING & ZERO

Live Working as an Example of Electrical Installation Maintenance with the Zero Accidents Philosophy

LW can be considered a contribution to safety and quality of electrical installation maintenance procedures on all voltage levels.





LIVE WORKING & ZERO

There have been quite a few attempts around the world to promote the concepts of maintenance work without accidents or with "zero accidents".

Organisations with an integrated management system (ISO 9001 & OHSAS 18001/ISO 45001)

have excellent organisational conditions for safe implementation of live working and can therefore achieve the goal of "zero defects" or the idea of "zero accidents" or "zero injuries" at work due to electrical shock and arc flash.

