

Case study: From seismic risk analysis to loss mitigation of a manufacturing plant

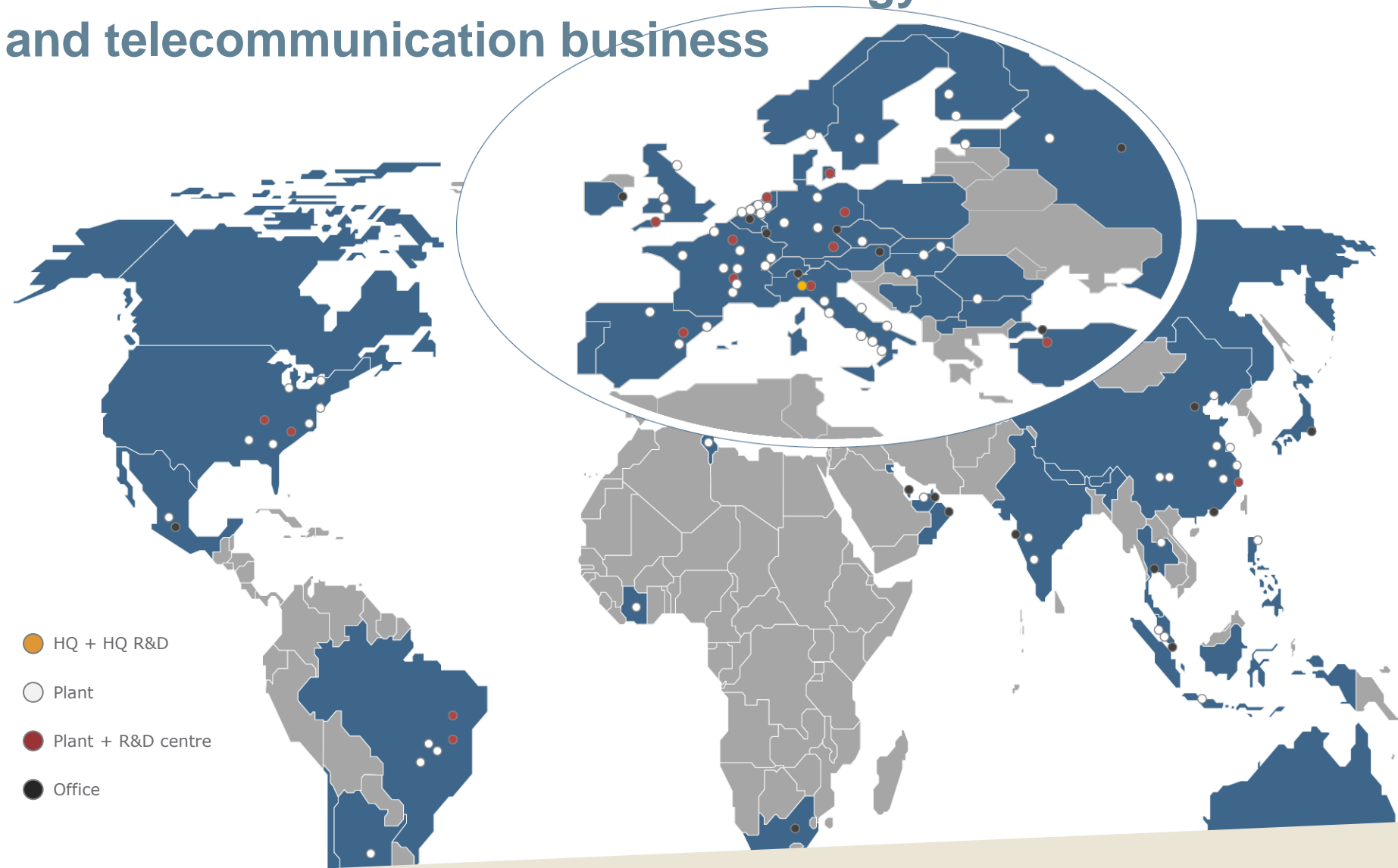
Seismic academy

Milano 27 October 2016

Prysmian
Group

PRYSMIAN
Draka

Leader in cable solutions for the energy and telecommunication business



- HQ + HQ R&D
- Plant
- Plant + R&D centre
- Office

Almost **140** years of history

50 countries

88 plants

17 R&D centres

Over **19,000** employees

About **7.5** billion sales in 2015

Submarine business and Arco Felice plant



- Submarine cable business represents about **10-15% on total Prysmian sales** and about **25-30% on contribution margin**.
- Business is carried out mainly through **Turn Key project** (supply and installation).



- Submarine cables are mainly of two different types: **paper** or PE/rubber extruded insulated.

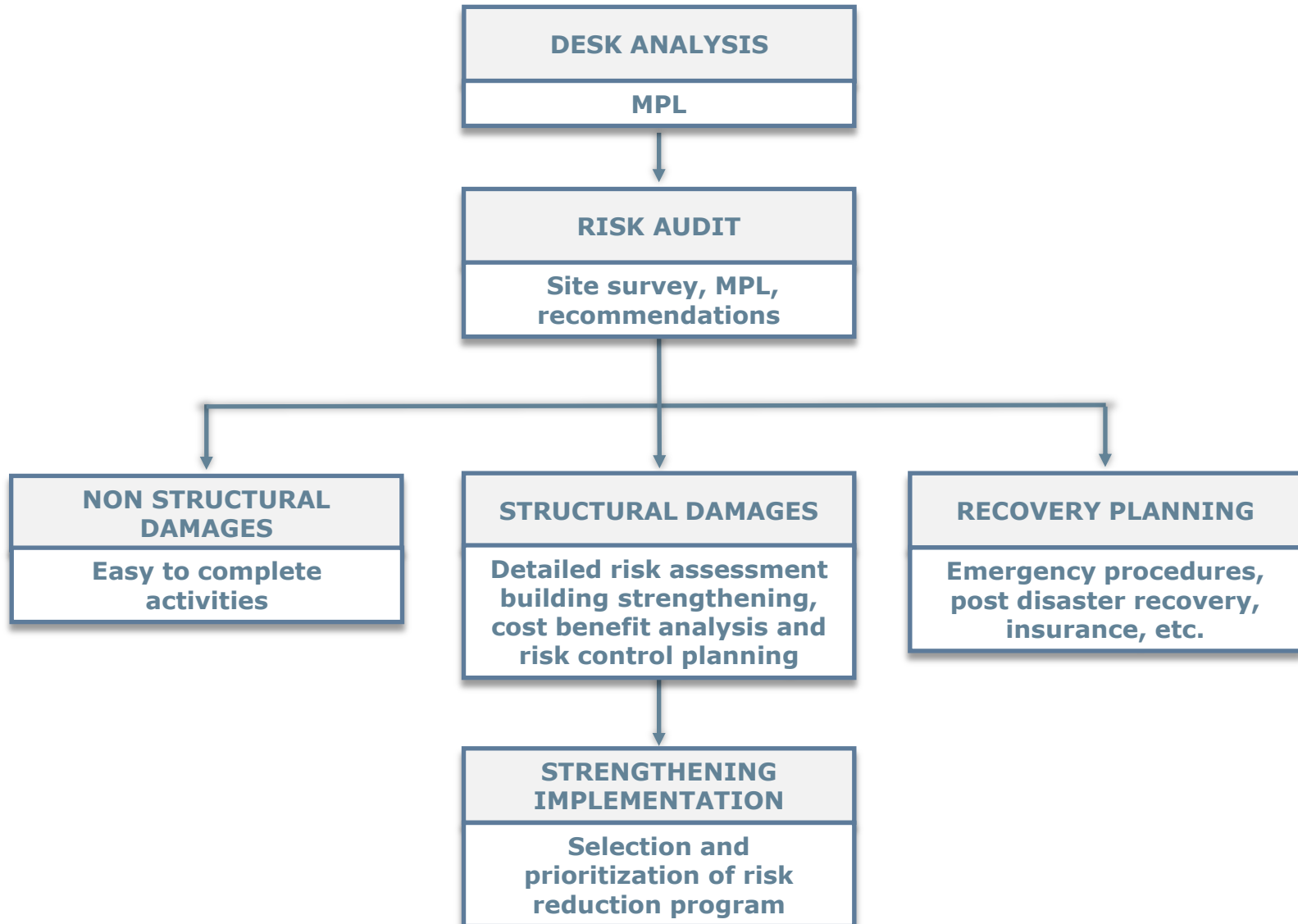


- Papers cable are manufactured **only in Arco Felice plant**.
- No spare capacity available.

Arco Felice plant



Risk reduction flow



Risk audit

Surveys have been carried out on major structures and equipment systems in order to:

- 1. Review the published **geologic information, fault maps, and seismic history** for the area to determine the site-specific seismic hazard levels.*
- 2. Observe **major seismic characteristics of the structures and equipment** systems, and general levels of equipment anchorage and bracing.*
- 3. Analyze **key production operations** and **earthquake preparedness** of plant management*
- 4. Prepare a report summarizing the **findings** and **recommendations**, including:*
 - an overview of the **regional seismicity**;*
 - preliminary **seismic risk ratings** (High, Medium, and Low risks);*
 - preliminary **MPL** ranges for the buildings at the site, along with downtime (business interruption) estimate ranges;*
 - observed **major seismic deficiencies**.*

Local soil conditions and seismicity



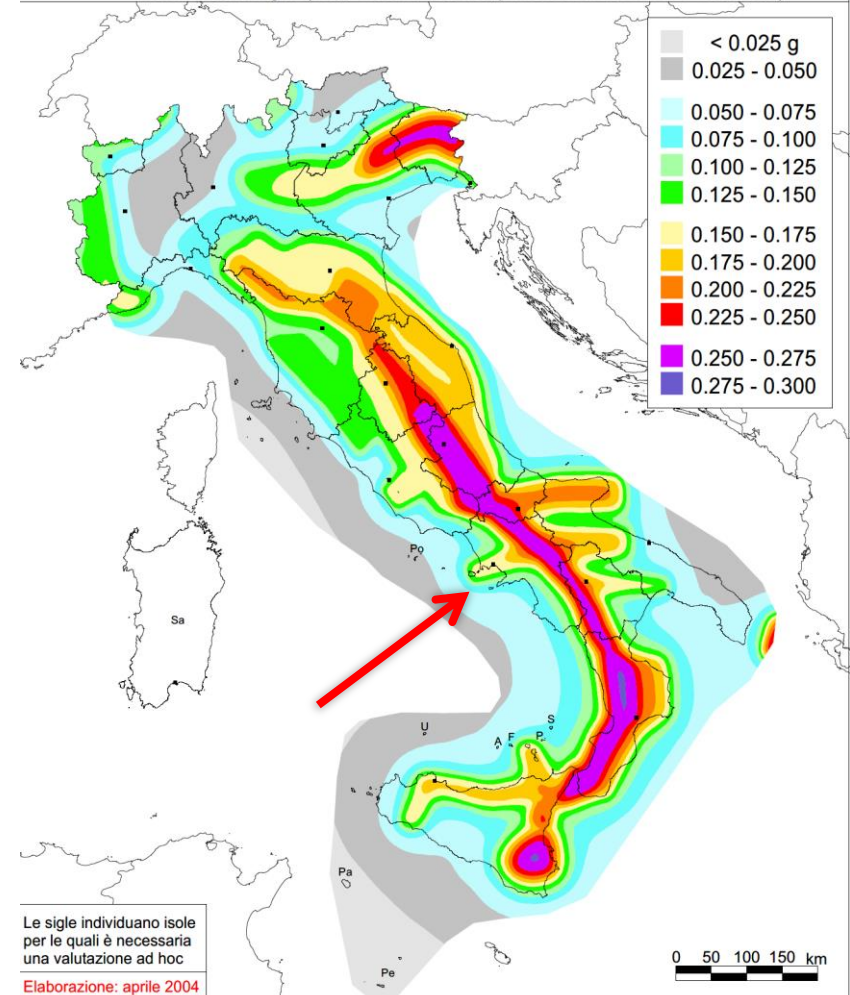
ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

Mappa di pericolosità sismica del territorio nazionale

(riferimento: Ordinanza PCM del 28 aprile 2006 n.3519, All. 1b)

espressa in termini di accelerazione massima del suolo
con probabilità di eccedenza del 10% in 50 anni

riferita a suoli rigidi ($V_{s30} > 800$ m/s; cat.A, punto 3.2.1 del D.M. 14.09.2005)



Considering the presence of **soft soil**, a **peak ground acceleration** of **0,25g - 0,30g** is expected for a **10% chance of exceedance in a 50 year period**.

Arco Felice plant lay out



Buildings 1 and 2 - Concrete



Bldg 1



Bldg 2

Buildings 3, 4 and 5 – Steel frame



Bldg 3



Bldg 4



Bldg 5



Bldg 5

Pier



Building characteristics

Bldg No. (*)	Year of Erection	No. of Stories	Surface Area	Construction Description	Occupancy
1	1950's	3+1	3,300 m ²	Cast-in-place reinforced concrete (RC) columns and decks, with non-ductile shear walls for horizontal loads stability. Horizontal RC roof.	Raw Material and UPS station at ground floor. Extrusion line heads at second floor. Offices above.
2	1954	1	8,500 m ²	High Bay reinforced concrete framed building with cast-in-place columns and beams and a heavy saw-toothed reinforced concrete roof. Horizontal loads are borne by the non-ductile concrete building frame.	Production of extruded submarine cables.
3	1960	1	9100 m ²	Steel framed construction with a partial high-bay. Steel roof with light corrugated cladding. Lateral resistance is provided by moment and braced frames. External walls are unreinforced non-load-bearing masonry, with higher parts clad in steel.	Production of paper insulated type submarine cables (south end), raw material warehouse (north end)
4	1954 (2007 addition)	1 + 1	17,500	Steel framed construction, with saw toothed steel roof. Lateral resistance is provided by moment frames and vertical braces. External walls are unreinforced non-load-bearing masonry. Building mainly one-story, with a two story addition recently erected in its west side.	Production of paper insulated submarine cables and optical fiber cables. Canteen and offices in the west, two story addition.
5	1954 (2007 addition)	1	6,800	Steel framed construction, with saw toothed steel roof. Lateral resistance is provided by moment frames and vertical braces. External walls are of unreinforced non-load-bearing masonry.	Raw Material Warehouse, finished product storage (cable on rotating platforms), cables testing area.
6	1960's			Pier with reinforced concrete columns and reinforced concrete deck.	Sea pier for cables ship loading.

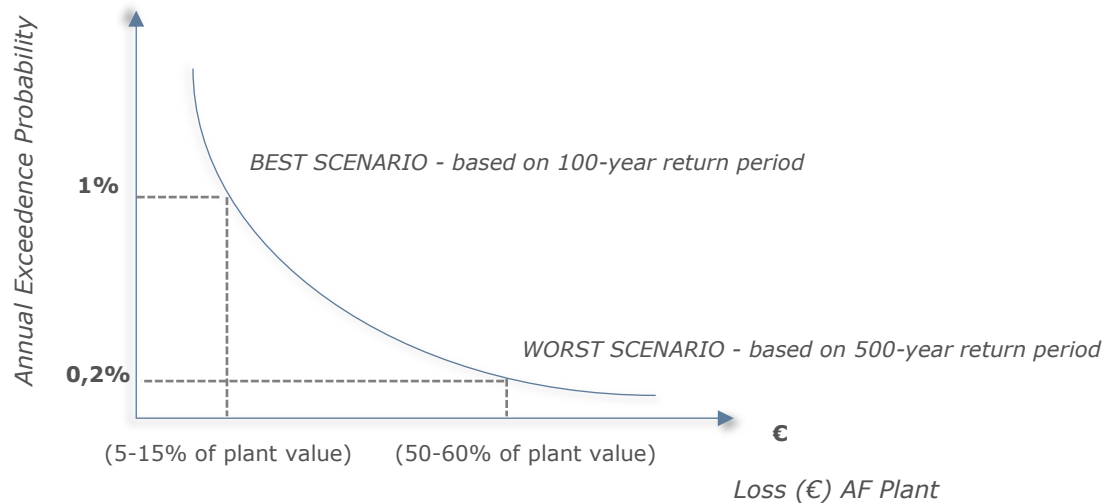
Arco Felice Earthquake Scenario MPL

Arco Felice earthquake Maximum Probable Loss (MPL) analysis is based on **two scenarios** of probability:

- 1) The **500-year** return period, which is the most common **standard used in the industry** for assessing seismic risk (equivalent to an annual exceedance probability of 0,2%)
- 2) The **100-year** return period, which is the probability related to **weak and moderate seismic events** (equivalent to an annual exceedance probability of 1,0%)

	Buildings *	Machinery	Stock	Business Interruption	Total
MPL 500 (%)	20-35%	25-35%	20-25%	12-18 months	50-60%

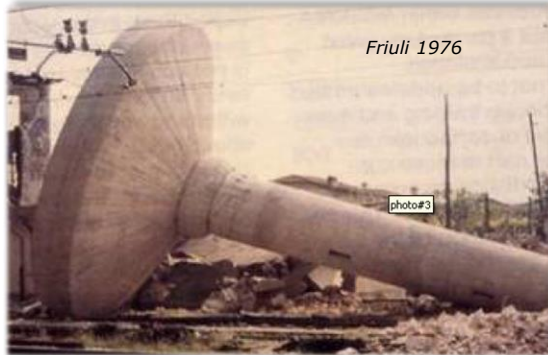
* 1 and 2: 30-50% 3, 4 and 5: 10-30%



Risk Mitigation

**SCENARIO 1)
500-YEAR RETURN**

→ **IX MMI**



**LOWER PROBABILITY
BUT
STRUCTURAL DAMAGES**

- *Masonry destroyed*
- *General damage to foundations*
- *Frame structures, if not bolted, shifted off foundations*
- *Frames racked*
- *Serious damages to reservoirs*
- *Underground pipes broken*
- *Conspicuous cracks in ground*
- *In alluvited areas, sand and mud ejected, creating earthquake fountains and sand craters*

**SCENARIO 2)
100-YEAR RETURN**

→ **VII MMI**



**HIGHER PROBABILITY
NON STRUCTURAL
DAMAGES**

- *Hanging objects quiver*
- *Furniture broken*
- *Damage to masonry including cracks*
- *Weak chimneys broken at roofline*
- *Fall of plaster, loose bricks, stones, tiles, cornices*

RISK MITIGATION

STRUCTURAL STRENGTHENING

HIGH COST



EASY TO COMPLETE ACTIVITIES

LOW COST



Risk mitigation – Low cost easy to complete



Example on unanchored electrical panels (Electrical Room n°1)

Risk mitigation – Low cost easy to complete



Example on missing anchorage

Risk mitigation – Low cost easy to complete



Example on inadequate anchorage

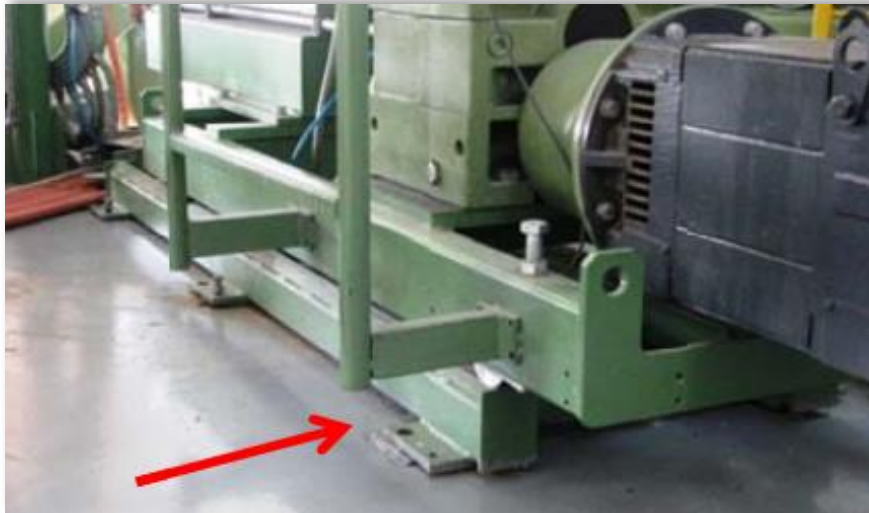
Risk mitigation – Low cost easy to complete



Main diesel generator – Missing anchorage



Missing anchorage



Extrusion line - Missing anchorage

Risk mitigation – Low cost easy to complete



Example of overhead bridge crane with no derailing restraint



Risk mitigation – Low cost easy to complete



Examples of unblocked cable reels



Risk mitigation – Low cost easy to complete



**Typical non structural wall arrangement
unreinforced masonry wall braced by a steel
frame**



Risk mitigation – Low cost easy to complete



Typical suspended racks with no bracings

SEISMIC M16

CE  II 3G - II 3D
MAGAS-II



Typical seismic gas shutoff valve

Building structural analysis and retrofitting

- 1. Geotechnical and geophysical characteristics review*
- 2. Buildings' drawings preparation (many missing drawings)*
- 3. Structural sampling campaigns*
- 4. Numerical analysis of buildings and structures (FEM model)*
- 5. Estimation of cost facility strengthening*
- 6. Cost benefit analysis and prioritization of risk mitigation program*
- 7. Strengthening design*
- 8. Strengthening implementation*



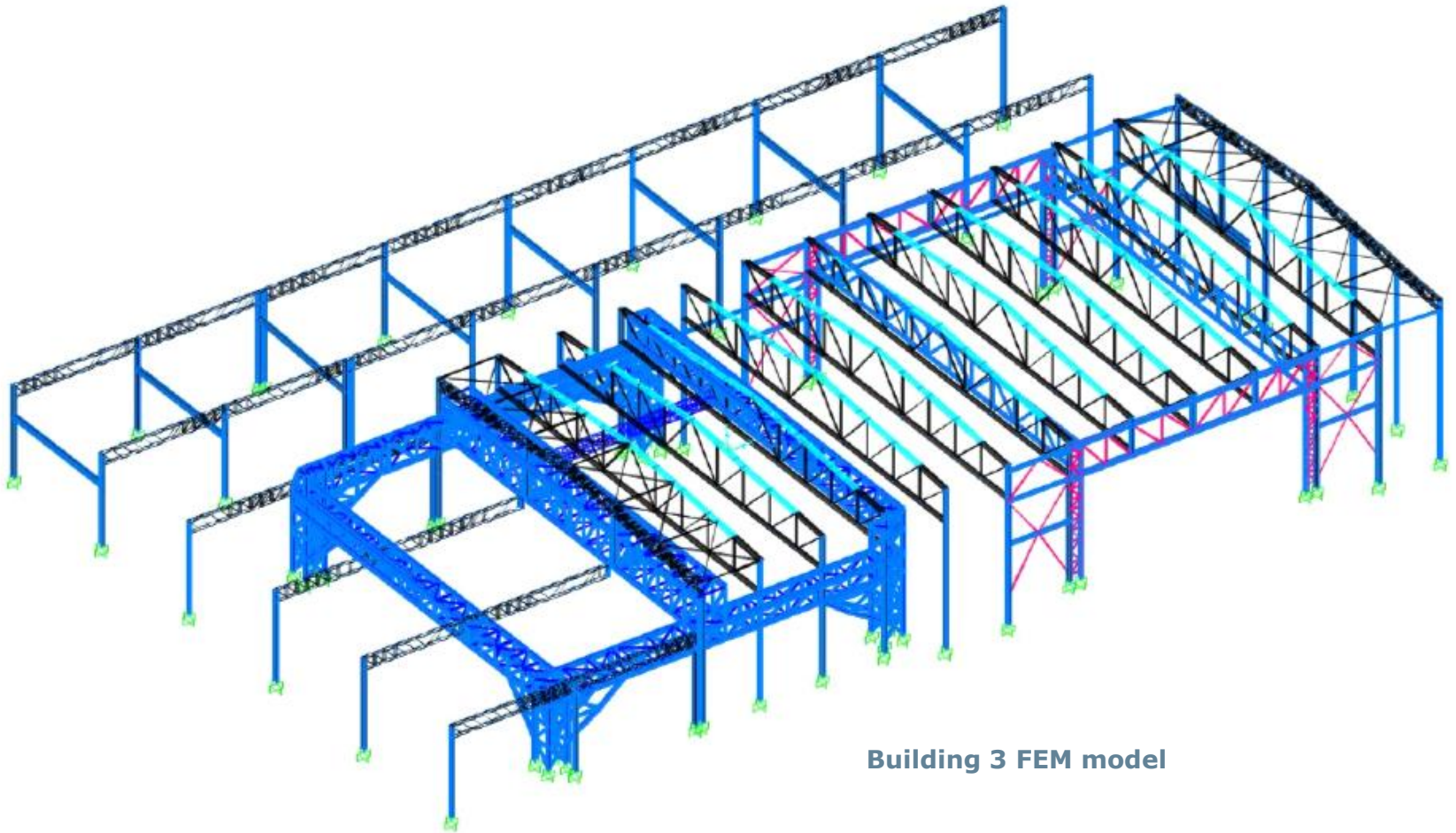
Soil sampling in building 1

Building structural analysis



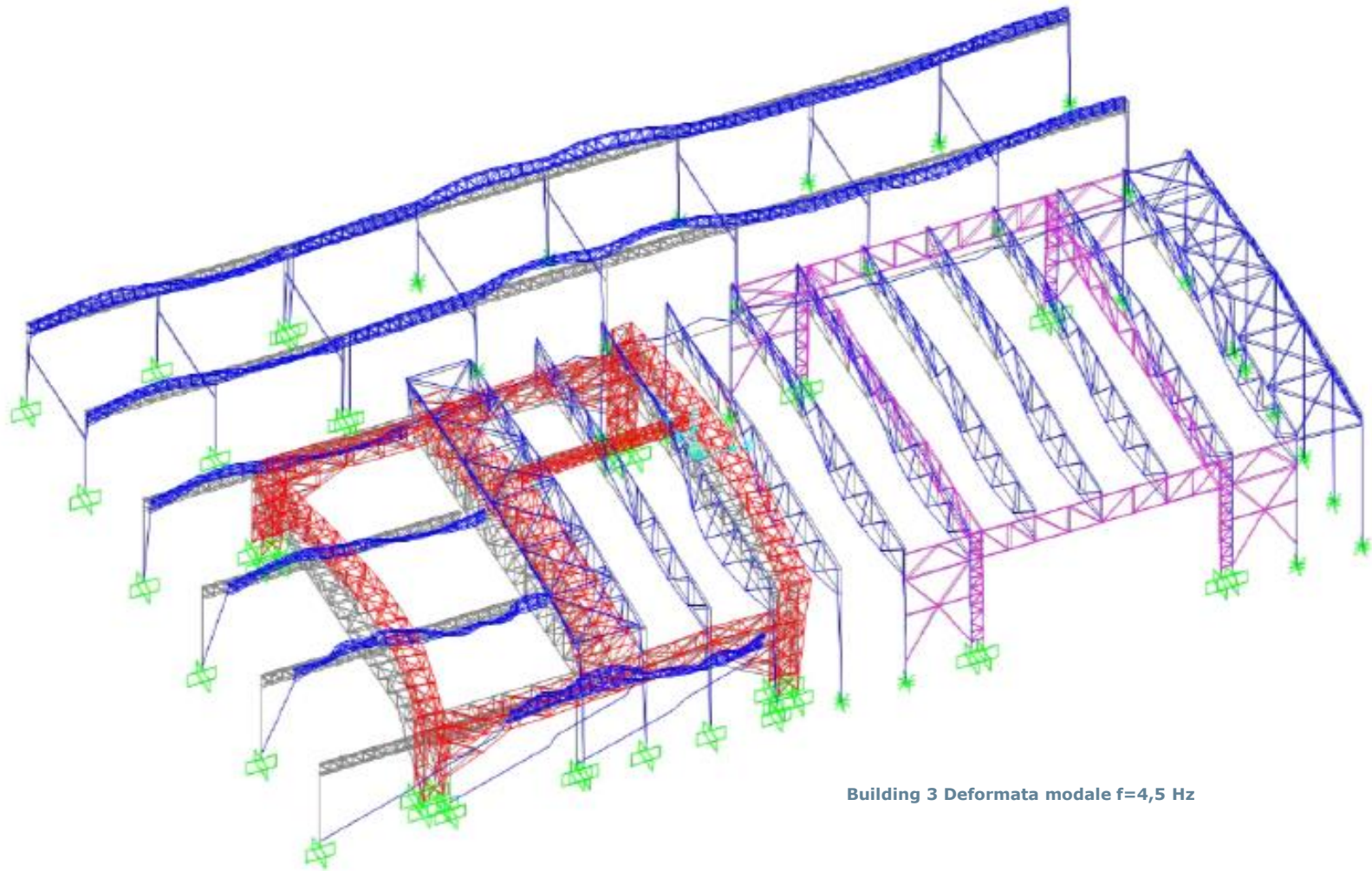
2003 Pictures

Building structural analysis



Building 3 FEM model

Building structural analysis



Building 3 Deformata modale $f=4,5$ Hz

Familiarization survey and disaster recovery with Belfor

BELFOR (●)



PIANO DI FAMILIARIZZAZIONE

Prysmian Power Link S.r.l.

NUMERO VERDE DI PRONTO INTERVENTO

800 820 189

24 ore su 24 - 365 gg l'anno

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21010 Cardano al Campo (VA)

Tel: +39 0331 730 787 Fax: +39 0331 730 836

www.belfor.it

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BELFOR (●)

Scheda Azienda: informazioni anagrafiche e di emergenza

REFERENTE CLIENTE IN CASO DI EMERGENZA	BERNARDO SALVATORE
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EMAIL	salvatore.bernardo@prysmiangroup.com
RED ALERT® CONTRATTO NR.	IT/P/000/120000
RAGIONE SOCIALE	PRYSMIAN POWER LINK S.R.L.
INDIRIZZO SITO	Via Anzecchino 93, Arco Felice - Pozzuoli (NA)
TELEFONO	0818677232
FAX	0266132559
SEGMENTO DI ATTIVITA'	Produzione Cavi trasporto energia elettrica
PERSONALE IMPIEGATO	530 Dipendenti + 100 Esterni
COMPAGNIA ASSICURATRICE	
AGENZIA ASSICURATRICE	
BROKER	
ALTRI CONSULENTI	

Familiarization Survey

DATA SURVEY	04 Febbraio 2014
INCARICATO BELFOR ITALIA	Ing. Bordignon Andrea
REFERENTE CLIENTE DURANTE SURVEY	Marco Pisciotta - Deputy Risk Manager
CELLULARE	+39 335 7764968
EMAIL	Marco.pisciotta@prysmiangroup.com

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Familiarization survey and disaster recovery with Belfor

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Sezione 4 Ubicazione di apparecchiature e macchinari critici



Sulla base del piano di business continuity ogni reparto aziendale definisce la lista delle apparecchiature e dei macchinari critici che viene gestita dal Team preposto alla gestione dell'emergenza.

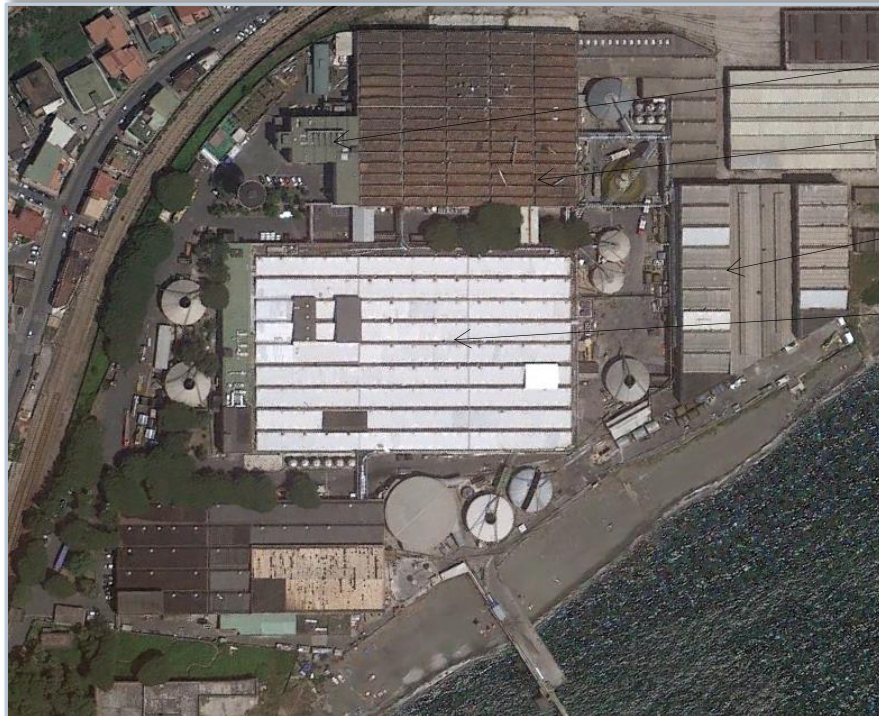
Nello schema sottostante riproduciamo la lista completa per consentire - in caso di intervento - al personale tecnico BELFOR di svolgere le operazioni di salvataggio e ripristino con la massima tempestività ed efficacia.

ITEM	CARATTERISTICHE	PIANO	UBICAZIONE
CENTRALINA ENEL	MEDIA TENSIONE 20 KV	0	NORD - OVEST nei pressi della sala compressori
CENTRALINA TELECOM		0	Sull'accesso al sito SUD-OVEST nella portineria
SALA COMPRESSORI	2 X 6000 MC/H + 1 X 8000 MC/H	0	
SALA CALDAIE	VAPORE 2 X 2,5 Ton/h + 2 x 3 Ton/h	0	A ridosso della parte EST Fabbricato "SAPEI"
CHILLER	1 X 600 KW frigoriferi	0	A ridosso della parte EST Fabbricato "SAPEI"
CHILLER	1 X 600 KW frigoriferi	0	A ridosso della parte OVEST Fabbricato "SAOI"
GRUPPO ELETTROGENO	1 X 1000 KVA Non di emergenza	0	A ridosso della parte EST Fabbricato "SAPEI"
GRUPPO ELETTROGENO	1 X 800 KVA Non di emergenza	0	A ridosso della parte EST Fabbricato "SAPEI"
SALA UPS	4 X 800 KVA	0	A NORD degli UFFICI
DEGASAGGIO SAPEI	Sistema di Degasaggio	0	A SUD fabbricato SAPEI
DEGASAGGIO SAOI	Sistema di Degasaggio	0	A NORD fabbricato SAOI
IMPIANTO DI DEPURAZIONE	Depurazione dei pluviali	0	A SUD sulla destra del Pontile
CABINA DECOMPRESSIONE METANO		0	Ad OVEST del Fabbricato SAPEI
LINEA CORDATURA	E' unica e customizzata	0	Su Fabbricato ESTRUSI
LINEA PIOMBO POLIETILENE		0	Su Fabbricato ESTRUSI
LINEA ARMATURA	Impianto Customizzato	0	Su Fabbricato ESTRUSI
PIATTAFORME PF	Piattaforme Customizzate per impilaggio prodotto finito	0	Denominate R4 in planimetria

Arco Felice Fire Following Scenario MFL

Bldg. No. in MFL Area	Property Damage Insured Value (Euro)									XXXXX
	Building			Machinery & Equipment			Stock & Supplies			Total
	Total Value	% Damage	Damage Value	Total Value	% Damage	Damage Value	Total Value	% Damage	Damage Value	MFL Damage Value
1		90			90			100		
2		90			90			100		
3		100			100			100		
4		90			90			100		
SUBTOTAL										
Total PD MFL										XXXXX
PD MFL as % of PD Insured Value										55%

Business Interruption MFL Calculation (Euro)		
BI Insured Value (on 24 months indemnity period)		XXXXX
No. Months	% of BI	
24	80	XXXXX
Subtotal		XXXXX
additional expenses & extra costs (about 5%)		XXXXX
Total BI MFL		XXXXX
BI MFL as % of BI Insured Value		84,0%



Building 1

Building 2

Building 3

Building 4

COMBINED PD/BI MFL (Euro)	
Total Insured Value	XXXXX
Property Damage MFL	XXXXX
Business Interruption MFL	XXXXX
PD/BI MFL	XXXXX
MFL % on TIV	70,90%

Fire Loss prevention and control



Fire Loss prevention and control



Fire Loss prevention and control



Thank you!

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