

TECH-6: Curriculum Vitae (CV) for Proposed Professional Staff

1. **Proposed Position:** Team Leader
2. **Name of Firm:** Studio Ing. G. Pietrangeli s.r.l.
3. **Name of Staff:** Antonio PIETRANGELI
4. **Date of Birth:** 26-12-1970 **Nationality:** Italian
5. **Education:** MSc in Civil & Hydraulic Engineering, University of Rome, 1999
6. **Membership of Professional Associations:**
 - Member of the Italian Consulting Engineers Register of Rome, 1999
 - International Commission On Large Dams (ICOLD), since 2003
 - Technical committee: sedimentation in reservoirs, from 2006 to 2010
 - Technical committee: dam hydraulics, since 2011 to date
 - Steering committee of the Italian Commission (ITCOLD), since 2008 to present
7. **Other Training / Academic Experience**
 - Adjunct Professor, Master in Geotechnical Engineering (Pro-Geo), University of Rome La Sapienza, 2014/15
 - Lecturer on Dams and Hydropower Development, Continuing Professional Education (CPE), Italian Consulting Engineers Register of Rome, 2014/2015
 - Various technical specialization courses, among which:
 - Dams and Hydropower Development, Italian Consulting Engineers Register of Rome, 2014/2015
 - Guest lecturer at department of Geography & Geology, University of West Indies, Jamaica, December 2013
 - Delegate at ICOLD Congresses: Tehran 2005, Barcelona 2006, St. Petersburg 2007, Luzern 2011, Kyoto 2012.
 - Delegate at Hydropower and Dams conferences: Ljubljana 2008, Lisbon 2010, Bilbao 2012
8. **Countries of Work Experience:** Albania, Bosnia, Bulgaria, Burundi, Ecuador, Eritrea, Ethiopia, Georgia, Israel, Italy, Jamaica, Malawi, México, Montenegro, Nigeria, R.D.Congo, Romania, Rwanda, Sierra Leone, Tanzania, Turkey, Uganda, Zambia, Zimbabwe.
9. **Languages:**

	<i>Speaking</i>	<i>Reading</i>	<i>Writing</i>
English	Excellent	Excellent	Excellent
Spanish	Good	Excellent	Excellent
French	Excellent	Excellent	Excellent
Italian	Mother Tongue		

10. Key Qualifications:

Mr. A. Pietrangeli has 18 years' international experience in the design and supervision of construction of large dams and hydropower plants.

Since 2006, as a managing partner of Studio Pietrangeli, he has been directly responsible for the technical direction and overall management of many of the firm's projects covering 24 large dams (up to 240 m high) and 18 large hydroelectric plants (totaling more than 10.000 MW).

He has acquired a remarkable specific experience as a team leader/project manager of about 15 large dams or hydropower projects in Africa, Europe and South America including Gibe III (1870 MW) which comprises the world's highest RCC dam (H = 240 m) currently under construction.

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Mr. A. Pietrangeli participates to the ITCOLD steering committee and has been member of ICOLD committees.

11. Employment Record:

From: 1997	To: date
Employer:	Studio Ing. G. Pietrangeli s.r.l.
Positions held:	Managing Partner (since 2006), Team Leader, Project Manager, Geotechnical Expert, Dam Designer, Hydraulic Expert.

12. Detailed Tasks Assigned

13. Work Undertaken that Best Illustrates Capability to Handle the Tasks Assigned:

BATOKA GORGE Hydro-Electric Scheme

Year: 2014 – in progress

Location: Zambia and Zimbabwe

Client: Zambezi River Authority

Main project features: Batoka Gorge (IP = 1600 MW) is a hydropower plant located on the Zambezi River between Victoria Falls and the existing Lake Kariba. The project is a trans-boundary plant having the following basic features:

- Batoka Dam (RCC Arch-Gravity Dam, H = 181 m, Crest Length = 767 m, Concrete volume V = 4 Mm³)
- Spillway (Q= 20.000 m³/s, Radial gated on dam crest, No. 7 gates 14x13 m)
- Headrace Tunnels (No. 4 (2+2) , D = 8,9 m, L = 250---450 m)
- Penstock Shaft (No. 4, D = 7 m, L = 120 m)
- Power House (No. 2, underground type, No. 4x2 Francis Turbines, Q = 1000 m³/s, IP = 1600 MW)
- Transmission Lines (L = 200 km - 330 kV in Zambia, L=140 km 420 kV in Zimbabwe)

Position held: Project manager

Activities performed: Pre-feasibility study (Confirmation of scheme layout), Feasibility Study, Tender Design, Tender Documents

VRANDUK HYDRO POWER PROJECT (IP = 22 MW)

Year: 2013 – in progress

Location: Bosnia and Herzegovina

Client: JP ELEKTROPRIVREDA BiH d.d.

Main project features: Vranduk HPP consists in a run-of-the-river power plant with an installed power of 22 MW. The main works are:

- Mobile Concrete Weir (H = 19 m, L = 119 m, No. 4 Radial Gates 10x12 m);
- Intake (W = 21.6 m, H = 16 m , No. 3 Gates – No. 2 Auxiliary Gates + No. 1 Main Gate);
- Power Tunnel (D = 6.6 m, L = 1,450 m)
- Power Houses No 2:
 - Small Unit (Q = 18 m³/s, H = 8.5 m, No. 1 Kaplan S Turbine, IP = 1.3 MW)
 - Main Unit (Q = 100 m³/s, H = 21 m, No. 2 Kaplan S Turbine, IP = 2x10 MW)

Position held: Dam expert

Activities performed: Review of preliminary design, tender documents, assistance during procurement; Supervision of construction (review of design documents, project management, site management, monitoring and supervision of the works, etc.).

LOWER DIAMPHWE Multipurpose Dam. Water Supply and Irrigation Scheme.

Year: 2013 – in progress

Location: Malawi

Client: Ministry of Water Development and Irrigation, Malawi

Main project features: Lower Diamphwe dam and associated structures (water supply and irrigation scheme) including the following works:

- Lower Diamphwe Dam (Rockfill type, H = 28 m, L = 450)
 - Saddle Dam (Type = Rockfill with clay core, H = 6.6 m)
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- Spillway (Overflowing type, $Q = 1350 \text{ m}^3/\text{s}$, $L_{\text{sill}} = 218 \text{ m}$)
- Culverts ($n^{\circ}2$, $Q = 145 \text{ m}^3/\text{s}$, $L = 20 \text{ m}$)
- Water Intake (Water supply gate = $1.4 \times 1.4 \text{ m}$, Irrigation gate = $0.8 \times 0.8 \text{ m}$)
- Pipeline ($L = 40 \text{ km}$, $D = 1100 - 1500 \text{ mm}$)
- Irrigation Scheme (approx. $A = 1,000 \text{ Ha}$)

Position held: Dam expert

Activities performed: Review and upgrade of feasibility studies, Detailed Design, tender documents

JAMAICA – Five Hpps (IP = 11.3 MW)

Year: 2013 – in progress

Location: Jamaica

Client: Ministry of Science, Technology, Energy and Mining

Main project features: This project includes prefeasibility and feasibility studies for five small hydropower plants. The basic features of the schemes are the following:

- Morgan's River (No. 2 Weirs, Pipe $L = 5.5 \text{ km}$ $D = 0.75 \text{ m}$, IP = 2.3 MW, No. 1 Pelton)
- Negro River (Weir, Canal/pipe $L = 2.8 \text{ km}$, IP = 2.3 MW, No. 1 Pelton)
- Spanish River (Divers. Dam, Tunnel $L = 0.6 \text{ km}$ $D = 2 \text{ m}$, IP = 1.5 + 0.6 MW, No. 2 Francis)
- Rio Cobre (Weir $H = 9 \text{ m}$, Spillway $Q = 1020 \text{ m}^3/\text{s}$, IP = 1.5 MW, No. 2 Hydro-Matrix)
- Martha's Brae (Weir, Canal $L = 2.7 \text{ km}$, Tunnel $L = 750 \text{ m}$, IP = 5 MW, No. 2 Francis)

Position held: Dam expert

Activities performed: Prefeasibility study, Feasibility study, Investigations, Environmental and social impact assessment

CARPAT (FRASIN-PANGARATI) Pumped Storage Plant (IP = 300 MW)

Year: 2012 – 2014

Location: Romania

Client: Water Energy Systems SRL

Main project features: Pumped storage plant (IP = 300 MW) making use of the existing Izvorul Muntelui Reservoir, including the following works:

- Upper Reservoir ($V = 2.8 \text{ Mm}^3$)
- Steel penstock ($L = 2400 \text{ m}$, $D = 3.8 - 3.0 \text{ m}$)
- Penstock shaft ($H = 280 \text{ m}$, $D = 3 \text{ m}$)
- Underground Power House ($N^{\circ} 2$ reversible Francis turbines, IP = $2 \times 150 \text{ MW}$)

Position held: Team Leader

Activities performed: Feasibility study, Final design, Detailed design, Tender documents

KOKHAV HAYARDEN – PSP

Year: 2013

Location: Israel

Client: Hutchinson Water International Holdings (HWL)

Main project features: The basic features of this Pumping Storage Plant are the following:

- Upper Dam (Earthfill, $H = 25 \text{ m}$, $L = 1.8 \text{ km}$, Vol. = 1.5 Mm^3 , Live Storage = 3.1 Mm^3)
- Lower Dam (Rockfill w., $H = 18 \text{ m}$, $L = 1.7 \text{ km}$, Vol. = 0.2 Mm^2 , Live Storage = 2.8 Mm^3)
- Headrace tunnel ($L = 755 \text{ m}$, $D = 5.5 \text{ m}$, Concrete Lining)
- Upper Surge Shaft ($H = 48 \text{ m}$, $D = 14 \text{ m}$)
- Penstock ($H = 670 \text{ m}$, $D = 4$)
- Underground Power House ($N^{\circ}2$ Francis turbines, IP = 300 MW)
- Tailrace Tunnel ($L = 1.6 \text{ km}$, $D = 5.5 \text{ m}$)

Position held: Team Leader

Activities performed: Due diligence of the existing studies: Feasibility design, Final design, Tender documents and Contractor's proposals.

GUAYLLABAMBA HPPs: Cuenca alta (310MW), Cuenca media y baja (1,160MW)

Year: 2012 – 2013

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Location: Ecuador

Client: Instituto Nacional de Preinversión

Main project features: The Cuenca Alta includes San Pedro HPP (50 MW) :

- Gravity Dam (H = 50 m, L = 100 m, V = 50.000 m³)
- Underground power house (No.2 Francis turbines, Rated Power 50 MW)

together with the downstream plant Calderón+Cubi (260 MW):

- Gravity Dam (H = 115 m, L = 192 m, V = 320.000 m³)
- Underground power house (No.4 Pelton turbines, IP = 260 MW)

The “Cuenca media y baja” includes : Chespi (468 MW), Chontal (194 MW), Chirapi (157,5 MW), Manduriacu (60 MW), Tortugo (201 MW), Tigre (80 MW)

Position held: Dam Expert

Activities performed: Cuenca Alta: Investigations, Prefeasibility study; Cuenca Media y baja: Optimization of existing projects, Master Plan

NAMAKHVANI HPP Cascade (Tvishi + Namakhvani + Zhoneti, IP_tot = 450 MW)

Year: 2012 – in progress

Location: Georgia

Client: JSC Namakhvani hpp Cascade

Main project features: The project envisages the construction under an EPC contract of three hydropower projects with the following basic features :

Tvishi:

- CVC gravity dam (H = 56.5 m, L = 100 m, V_{res} = 13.1 Mm³)
- Open air Power house (No. 2 Kaplan turbines, IP = 2x50 MW)

Namakhvani:

- Concrete arch dam (H = 111.0 m, L = 315 m, V_{res} = 156 Mm³)
- Open air Power house (No. 3 Francis turbines, IP = 3x85 MW)

Zhoneti:

- Rockfill dam with bituminous core (H = 31 m, L = 174 m, V_{res} = 12.5 Mm³)
- Open air Power house (No. 2 Kaplan turbines, IP = 2x50 MW)

Position held: Team Leader

Activities performed: Review and Upgrade of Feasibility Study, Tender Documents, Consultancy for Tender, Assistance during procurement, Supervision of Construction

RUZIZI transmission lines and dams rehabilitation

Year: 2012 – 2014

Location: Congo, Burundi and Rwanda

Client: Organisation pour l'Énergie des pays des grand Lacs, Union Européenne

Main project features: The main components of the projects are :

- Kamanyola Station and National Dispatching Centre
- Cascade Coordination Centre
- Transmission Line (N°2, L_{TOT} = 100 Km, 220 kV)
- Rehabilitation and upgrading of Ruzizi I and Ruzizi II
- Ruzizi I Gravity Dam (H=15m, L=195m), Outdoor PH (N°4 Kaplan, IP=29.8 MW)
- Ruzizi II Gravity Dam (H=14 m, L=85m), Outdoor PH (N°3 Francis, IP=44 MW)

Position held: Dam Expert

Activities performed: Feasibility Study, Final Design, Tender Documents, ESIA of Kamanyola Station, Transmission Lines, and Cascade Coordination Centre. Investigations, Design and studies of rehabilitation works for the Dams

MITA HILLS dam refurbishment and upgrading

Year: 2011 – 2012

Location: Zambia

Client: Lunsenfwa Hydropower Company

Main project features: The upgrade of the existing Mita Hills dam (Earthfill/Rockfill, H = 40m, L=330m) includes what follows to increase the reservoir volume and for

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refurbishment:

- Current set-up / proposed set-up :
 - Reservoir ($V_{RES} = 680 \text{ Mm}^3$ / $V_{RES} = 850 \text{ Mm}^3$)
 - Spillway (N°2 gates 9x9 m, N°2 erodible fill embankments L = 20 m / N°2 gates 10x12 m, N°1 emergency fuse gate L = 40m)
- Intake Tower (H=80 m, N° 2 Radial Gates)

Position held: Dam expert

Activities performed: Assessment of the Existing Plant, Pre-Feasibility Studies, Feasibility Design for the refurbishment and upgrading

RUMAKALI Hydroelectric Power Plant (IP = 525 MW)

Year: 2011 – 2013

Location: Tanzania

Client: Zarubezhstroy Ojsc; Beneficiary: Ministry of Energy and Minerals

Main project features: Hydroelectric Power Plant including the following works :

- Rumakali Dam (H= 90m, BFRD type)
- North Site main Dam (H = 63 m, BFRD type)
- East Site main Dam (H = 44 m, BFRD type)
- Underground Power House (WxLxH = 180 x 23 x 44 m, Design Head = 1,423 m, Q = 42 m³/s, N°4 Turbines Pelton)
- Transmission line (Voltage 220 Kv, Total Length = 70 Km)

Position held: Dam Expert

Activities performed: Conceptual Scheme, Feasibility Design, BOT Contract documents

KIDUNDA dam for water supply, irrigation and hydropower (IP = 20 MW)

Year: 2010 – in progress

Location: Tanzania

Client: Dar es Salaam Water & Sewage Authority (DAWASA)

Main project features: Dam project for irrigation, water supply and hydropower purposes including the following works:

- Reservoir (C.A. = 78 Km², Live Storage = 280 Mm³)
- Dam (Bituminous Facing Rockfill Dam type, H=21 m, L= 860 m)
- Spillway (Gated type, L = 133 m, Gates N° 8, Q = 3,500 m³/s)
- Intake Tower (H = 25 m, Slide gates N° 4, 6x6 m)
- Outdoor Power House (IP = 20 MW, Kaplan turbines N° 2, E = 60 GWh/y)

Position held: Hydraulic and Geotechnical Expert

Activities performed: Topographical Survey and GIS of Dar es Salaam area, Feasibility study, Final Design, Environmental and Social Impact Assessment

MUCHINGA Hydropower Plant (IP = 255 MW)

Year: 2010 - 2012

Location: Zambia

Client: Muchinga Power Company

Main project features: Hydropower project (IP = 255 MW) exploiting the waters regulated by the existing Mita Hills dam, including the following works:

- Mkushi Dam (Arch type, H = 120 m, L = 350 m)
- N°2 Power Tunnels (L= 9+8 km, D = 5)
- Penstocks (N°3, D = 2.2 m, L = 1,000 m)
- Power House: (Outdoor, N° 3 x 85MW Pelton Turbines)

Position held: Team Leader for the feasibility study

Activities performed: Conceptual Design, Feasibility study (up to investigations)

CHESPI Hydropower Plant (IP = 468 MW)

Year: 2009 - 2012

Location: Ecuador

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Client: Hidroequinoccio HEQ S.A.

Main project features: Chespi hydroelectric project (IP = 468 MW) includes the following works:

- Reservoir (Live Storage = 2.3 Mm³)
- Arch dam (H = 68 m, L = 144 m, V = 45,000 m³)
- Penstock (L = 1,000 m, D = 4-3.4 m)
- Headrace tunnel (L = 18.3 Km, D = 5.4 m)
- Tailrace tunnel (L = 6.3 Km, D = 6.4 m)
- Surge Shaft (H = 123 m, D = 15 m)
- Underground Power House (No. 4x117 MW Pelton turbines)

Position held: Team Leader for the waterways and powerhouse design

Activities performed: Investigations, Preliminary, Final and Detailed Design, Tender Documents

KYOGA-NILE HPPs Cascade (Kamdini + Kibaa + Murchison, IP_tot = 6,010 MW)

Year: 2008 - 2009

Location: Uganda

Client: Salini Costruttori S.p.A.; Beneficiary: Ministry of Water and Environment

Main project features: The basic features of the cascade are the following.

Kamdini (Karuma) is the 1st plant of the Kyoga-Nile HPPs cascade and includes :

- Rockfill Dam (H = 30 m, L = 480 m, V_{res} = 68 Mm³)
- Headrace Canals (L = 5.7 km, Bottom width = 15 m)
- Tailrace Tunnels (N° 2, L = 4 km, D = 14 m)
- Underground PH (N°10 Francis turbines, IP = 1,260 MW, H_{net} = 64 m)

Kibaa is the 2nd plant of the Kyoga-Nile cascade and includes :

- Rockfill Dam (H = 53 m, L = 2,150 m, V_{RES} = 300 Mm³)
- Headrace Canals (L = 10 km, Bottom width = 14 m)
- Tailrace Tunnels (N°2, L = 4.5 km, D = 14 m)
- Underground PH (N°16 Francis turbines, IP = 2,600 MW, H_{net} = 131 m)

Murchison is the 3th plant of the Kyoga-Nile cascade and includes :

- Rockfill Dam (H = 44 m, L = 1,300m, V_{RES} = 170 Mm³)
- Headrace Canal (Bottom Width = 14 m; L = 0.7 km)
- Tailrace Tunnels (N° 2, L = 5.5 km, D = 14 m)
- Underground PH (N° 14 Francis Turbines, IP = 2,150 MW, H_{net} = 107 m)

Position held: Team Leader

Activities performed: Pre-feasibility study, Feasibility study

MAMBILLA Hydroelectric Power Plant (IP = 4,000 MW)

Year: 2009

Location: Nigeria

Client: Salini Costruttori S.p.A.

Main project features: The hydroelectric Power Plant includes the following works :

- Gembu Dam (RCC dam, H = 100 m, L = 515 m)
- Sumsum Dam (RCC dam, H = 35 m, L = 460 m)
- Nghu Dam (Rockfill dam, H = 95 m, L = 680 m)
- Water transfer Tunnel (L = 16 Km, D = 6 m)
- Headrace canal (L = 3.1 Km, Width = 15 m)
- Power Shaft (N° 16, D = 5.25 – 8.40 m, Total L = 1,000 m)
- Underground PHs (N°2, N°16 Turbines Pelton, Q = 88 m³/s, IP = 16x250 MW)

Position held: Geotechnical Expert

Activities performed: Pre-Feasibility study, Feasibility study

TARA-MORACA Dam and Hydroelectric Power Plant (IP = 400 MW)

Year: 2008 - 2009

Location: Montenegro

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Client: Deutsche Bank

Main project features: Tara-Moraca Dam and HPP (IP = 400 MW), including the following works :

- Tara arch dam (H = 80 m)
- Canal (L = 14 km)
- Shaft (H = 700 m)
- Underground Power House (N°4 Turbines Pelton, IP = 400 MW)

Position held: Dam expert

Activities performed: Due diligence of the existing projects, pre-feasibility of alternative

GIBE V Hydroelectric Power Plant (IP = 660 MW)

Year: 2008 - 2009

Location: Ethiopia

Client: Salini Costruttori S.p.A.; Beneficiary : EEPKO

Main project features: Gibe V (IP = 660 MW) is the 5th stage of the Gibe-Omo cascade and includes the following works :

- RCC Gravity Dam (H = 78 m, L = 580 m)
- Gated Spillway (N°10 gates, Dimensions 12x19 m)
- River Diversions Works (N°2 culverts, D= 12 m, L=240 m)
- Cofferdam (Rockfill, H = 20 m, L = 240 m)
- Outdoor Power House (N° 10 Francis turbines, IP = 10x66 MW)

Position held: Dam specialist, Geotechnical expert

Activities performed: Reconnaissance Project, Feasibility Study

GIBE IV Hydroelectric Power Plant (IP = 1,480 MW)

Year: 2008 - 2009

Location: Ethiopia

Client: Salini Costruttori S.p.A., Beneficiary : EEPKO

Main project features: Gibe IV (IP = 1,480 MW) is the 4th stage of the Gibe-Omo cascade and includes the following works :

- RCC Gravity Dam (H = 165 m, L = 725)
- Gated Spillway (N°9 radial gates, Dimen. 12x19, Q = 22,000 m³/s)
- Power Waterways (No 2, L = 0.8 km, D = 12 m)
- D/S Rockfill Cofferdam (H = 27 m, L = 117 m)
- Outdoor Power House (N°8x185 MW Francis turbines)

Position held: Geotechnical expert

Activities performed: Reconnaissance Project, Feasibility Study

GIBE III Hydroelectric Power Plant (IP = 1,870 MW)

Year: 2005 – 2007, 2010 – 2011

Location: Ethiopia

Client: Salini Costruttori S.p.A., Beneficiary : Ethiopian Electric Power Corporation

Main project features: Gibe III (IP = 1,870 MW) is the 3rd stage of the Gibe-Omo cascade and will become the world's highest RCC dam. The project includes the following works :

- Reservoir (V_{RES}=14,700 Mm³)
 - RCC Gravity Dam (H=235 m, L_{CREST}=620 m, V_{RCC} = 6.5 Mm³)
 - Spillway (at dam crest, No. 7 gates 14x17.5 m, Q = 18,600 m³/s)
 - Middle outlet (in the dam body, No.2, Q = 1600 m³/s, L=100 m, D=5m)
 - Rockfill Cofferdam (H = 50 m, L = 205 m, Zig-Zag PVC membrane)
 - Main Diversion Tunnels (No. 2, L = 1.1 km, D = 14 m)
 - Preliminary Diversion Tunnel (No. 1, L= 1.1 km, D= 7 m)
 - Power Waterways (No 2, L = 1.0 km, D = 11 m)
 - Surge Shaft (No. 2, D = 20 m, H = 60 m)
 - Outdoor Power House (N°10x187 MW Francis turbines, Design Head = 211 m, Q =
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950 m³/s, Dimensions = 220 x 34 x 46 m)

- Switchyard (No. 5 line bays 400 kV, No. 5 transformers 15/400 kV)

Position held: Project Manager and Dam Designer (Reconnaissance, Basic Design, Final Design), geotechnical expert (technical supervision of construction)

Activities performed: Reconnaissance design, Investigations, Feasibility Study, Basic Design, Final Design, Construction Design, Technical Supervision during Construction

ARCEDIANO Pumped Storage Plant (IP = 296 MW)

Year: 2006

Location: Mexico

Client: CIPRO, Coordinacion de ingenieria de proyectos S.C

Main project features: The Arcediano Pumped storage plant (IP = 296 MW) is envisaged on the shores of Arcediano lake, created for water supply, and includes the following works :

- Penstock (L = 680 m, D = 2.8 m)
- Penstock shaft (L = 300 m, D = 2.8 m)
- Underground Power House with No.2 Francis turbines:
 - Rated Power (Turbine mode) each = 120 MW
 - Rated power (pumping mode) each = 148 MVA

Position held: Project Manager

Activities performed: Basic design (in collaboration with Cipro), Technical specification of Electromechanical and Hydromechanical works, Hydraulic studies

BUSALLETTA Dam Upgrade

Year: 2005 - 2008

Location: Italy

Client: Mediterranea delle acque S.p.a.

Main project features: Upgrade of the existing Busalletta dam, for water supply, increasing of the dam height and reservoir volumes. The project includes what follows :

- Current set-up / proposed set-up :
 - Reservoir ($V_{RES} = 5 \text{ Mm}^3$ / $V_{RES} = 6.5 \text{ Mm}^3$)
 - Dam (Concrete gravity dam, H = 50 m / H = 53 m)
 - Spillway (Ogee Overflow / Gated spillway with No. 5 flap gates, Dim. 2.1 x 12 m)

Position held: Team Leader

Activities performed: Pre-feasibility and Feasibility study

GIBE II Hydroelectric Power Plant (IP = 420 MW)

Year: 2003 - 2007

Location: Ethiopia

Client: Salini Costruttori S.p.A., Beneficiary : EEPKO

Main project features: Gibe II (IP = 420 MW) is the 2nd project of the Gibe-Omo cascade, making us of the waters regulated by the upstream Gilgel Gibe dam, and includes the following works:

- Concrete Gravity Dam (H=49m, L=140m, $V_{RES} = 1.9 \text{ M}^3/\text{s}$)
- Spillway (at dam crest, $Q = 2325 \text{ m}^3/\text{s}$)
- Intake (L = 24 m, H = 33 m, No. 2 roller gates)
- Power Tunnels (L = 26 km, D = 6 m, $Q = 101 \text{ m}^3/\text{s}$)
- Penstocks (No 2, L = 1.2 km, D = 2.4 m)
- Surge Shaft (H = 94 m, D = 18 m)
- Power House (Outdoor, No. 4x105 MW Pelton turbines, Design Head = 510 m, $Q_{des} = 110 \text{ m}^3/\text{s}$, Dim. 120 x 25 x 36 m)
- Switchyard (No. 2 line bays 400 kV, No. 4 transformers 400/15 kV)
- Access Roads (No. 3, L = 30 + 35 + 5.5 km)

Position held: Project manager and chief geotechnical engineer (Basic Design, Final Design), responsible for the engineering of the dam (all design phases)

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Activities performed: Reconnaissance design, Investigations, Basic Design, Final Design (Level 1 design) and Construction Design (Level 2 design) , Technical Assistance during Construction

RIO MANNU Gravity Dam for Water Supply and Irrigation

Year: 2003 - 2006

Location: Italy

Client: Consorzio di Bonifica della Sardegna Centrale

Main project features: Dam for water supply and irrigation to be built in two phases, including the following works :

- Phase 1: Gravity Dam ($H = 19$ m, $V_{RES} = 400.000 \text{ m}^3$)
- Phase 2: Gravity Dam ($H = 28$ m, $V_{RES} = 2.000.000 \text{ m}^3$)
- Spillway ($Q = 685 \text{ m}^3/\text{s}$, $L = 84\text{m}$)
- Outlet works ($Q = 36 \text{ m}^3/\text{s}$, No. 2 gates = roller + sliding)

Position held: Project Director

Activities performed: Preliminary, Final design and Detailed design

SANTU MIALI Hpp (IP = 27 MW) – Refurbishment and Upgrade

Year: 2003 - 2010

Location: Italy

Client: Sardinia Water Authority (Ente Acque della Sardegna ENAS)

Main project features: Refurbishment and upgrade of the Santu Miali hydropower plant, including:

- Reservoir (Daily regulated Vol. = 1.4 Mm^3)
- Headrace Tunnel ($L = 750$ m, $D = 4.25$ m)
- Surge Shaft ($H = 33.5$ m, $D = 8.20$ m)
- Underground Power House (Dimensions $34 \times 16 \times 31$ m, No. 1 Francis Turbine, 27.5 MW)
- Main Transformer (N°1, Nominal voltage = $9 / 150$ kV, Rated power = 320 MVA)

Position held: Team Leader for feasibility design, HPP expert (all design phases)

Activities performed: Preliminary design, Final design and Tender documents , Supervision of works (up to installation of the EM equipment)

UVINI Hpp (IP = 15.8 MW) - Refurbishment and Upgrading

Year: 2003 - 2010

Location: Italy

Client: Ente Autonomo del Flumendosa (EAF)

Main project features: Refurbishment of the Uvini hydropower plant:

- Reservoir (Total Reservoir Vol. = 320 Mm^3)
- Penstock (Diameter = 4.50 m)
- Underground Power House (D (circular plan) = 17 m, $H = 29.4$ m)
- Electromechanical Works: N° 2 Turbines (Kaplan + Francis), Total IP = 15.8 MW
- Main Transformers (N° 2)

Kaplan: No-load ratio = $9 / 70$ kV, Rated power = 17.5 MVA

Francis: No-load ratio = $0.4 / 15$ kV, Rated power = 1.6 MVA

Position held: Hydraulic Expert, Team Leader for Final Design and Supervision of Construction

Activities performed: Preliminary design, Final design and Tender documents , Supervision of works (up to installation of the EM equipment)

SAN LORENZO Hydropower Plant (IP = 1.2 MW)

Year: 2003 - 2008

Location: Italy

Client: Ente Autonomo del Flumendosa (EAF)

Main project features: Mini hydroelectric plant located on the water supply pipeline network of southern Sardinia, including the following works:

TECH-6: Curriculum Vitae (CV) for Proposed Professional Staff

- Outdoor Power House (L=16 m, W= 10 m, H= 7 m)
 - Electromechanical Works (N°1 Francis Turbine, IP = 1,250 kW, Max. Q = 1.2 m³/s, Design Head = 117 m)
 - Three-Phase Synchronous Alternator (6 kV/1,600 kVA, E = 7.2 GWh)
- Position held:** HPP expert
Activities performed: Investigations, Preliminary design, Final design and tender documents, Supervision of the works
-

SIMBIRIZZI Hydropower Plant (IP = 1,2 MW)

Year: 2003 - 2008

Location: Italy

Client: Ente Autonomo del Flumendosa (EAF)

Main project features: Mini hydroelectric plant located on the water supply pipeline network of southern Sardinia, including the following works :

- Outdoor Power House (L=18 m, W= 10 m, H= 7 m)
- Electromechanical Works (N°1 Francis Turbine, IP = 1,300 kW, Q = 2 m³/s, H = 75 m)
- Three-Phase Synchronous Alternator (6 kV/1,700 kVA, E = 6.5 GWh)

Position held: HPP expert

Activities performed: Investigations, Preliminary design, Final design and tender documents, Supervision of works

MACCHERONIS Dam Heightening and Upgrade

Year: 2003 - 2004

Location: Italy

Client: Lombardi SA; Beneficiary: Consorzio Bonifica della Sardegna Centrale

Main project features: Reservoir capacity augmentation through the heightening of an existing concrete gravity dam and through a new spillway, including:

- Reservoir ($V_{existing} = 25 \text{ Mm}^3$, $V_{final} = 35 \text{ Mm}^3$)
- Gravity Dam ($H_{existing} = 46 \text{ m}$, $H_{final} = 47 \text{ m}$, $L_{final} = 435 \text{ m}$)
- Spillway (existing : L = 198 m, Q = 2,643 m³/s, final L = 210 m, Q = 3,000 m³/s)
- Outlet Tunnel (L = 199 m, D = 3.5 m, Q = 65 m³/s)
- Inlet Tunnel (L = 432 m, D = 2 m)

Position held: Team Leader

Activities performed: Preliminary design and Final design of the dam heightening

ARCICHIARO Hydroelectric Power Plant (IP = 5 MW)

Year: 2002 - 2005

Location: Italy

Client: Vitaliani & Randich S.p.A. (IPP)

Main project features: Hydropower plant using the waters of the existing Arcichiaro dam. Major works are :

- Gutters (Q = 15 m³/s, L = 3.3 km and D = 1.2 - 1.5 m, L = 5 km and W = 1 m)
- Tunnel (L = 1 km, H = 3.7 m, W = 4 m)
- Power house (Dim. = 30 x 10 m, $Q_{MAX} = 2.3 \text{ m}^3/\text{s}$, IP = 5 MW)
- Electrical line (L = 5.5 km)

Position held: Geotechnical expert

Activities performed: Preliminary Design

ARDA CASCADE Hydroelectric Power Plant

Year: 2001 - 2002

Location: Bulgaria

Client: Enel Power S.p.A.

Main project features: The Arda cascade includes three existing hydropower plants (IP= 106 + 60 + 103 MW) and three proposed hydropower plants: Madan (IP = 47 MW), Sarnitsa (IP = 69 MW) and Ardino (56 MW + Mini hydro 2 MW).

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The feasibility study of Ardino HPP includes:

- RCC Arch-Gravity dam ($H=110$ m, $L=365$ m)
- Spillway ($Q = 2,500$ m³/s, No.6 flap gates 6x 6 m)
- Outdoor Power House (No. 2 Francis turbines 2x28 MW)
- No. 1 mini hydro (IP = 2 MW, E = 12.4 GWh/y)

Position held: Project Manager for preliminary design of Ardino alternative arch - gravity dam (RCC, $H=120$ m), Geotechnical expert

Activities performed: Review of all feasibility studies, in collaboration with Enel Power, Feasibility study of Ardino Hpp (including design of dam and appurtenances)

KALIVAC Hydroelectric Power Plant (IP = 108 MW)

Year: 2000 - 2001

Location: Albania

Client: Enel Power S.p.A.

Main project features: Hydropower Plant (IP = 108 MW) including the following works:

- Concrete Gravity Dam ($H=80$ m, $L=375$ m, $V_{RES}=350$ Mm³)
- River Diversion ($Q = 2,500$ m³/s)
- Spillway ($Q = 4500$ m³/s, N° 15 flap gates 5.5 x 12.5 m)
- Outlet (N°2, $Q_{MAX}=540$ m³/s)
- Intake (N°2, $Q_{MAX}=285$ m³/s)
- Outdoor Power House (N°2 Kaplan + N°1 Francis turbines)

Position held: Project Manager, Geotechnical expert (final design)

Activities performed: Investigations, Preliminary design, Final design of the civil works

BOSA Dam Refurbishment and Upgrading

Year: 1999 – 2004, 2007

Location: Italy

Client: Sardinia Autonomous Region, Ministry of Public Works Dam Division

Main project features: Change in destination of use of the existing Bosa Dam for drinking water supply and irrigation. The project includes the installation of regulating gates on the existing unregulated bottom outlet together with the refurbishment of the dam. Main works are:

- Bottom outlet gates (No. 4, roller + sliding, $H \times W = 5 \times 3.5$ m)
- Dam abutments stabilization
- Dam monitoring System

Position held: Project Manager (preliminary design) , Geotechnical and Dam Expert (Final design, Supervision of the works)

Activities performed: Investigations, Preliminary, Final design, Supervision of the works

GILGEL GIBE Hydroelectric Power Plant (IP = 200 MW)

Year: 2000 - 2002

Location: Ethiopia

Client: Enel Power S.p.A., Beneficiary : EEPCO

Main project features: Gilgel Gibe (IP = 200 MW) is the 1st hydropower plant of the Gibe-Omo Cascade. The main works of the project include:

- Rockfill Dam ($H=40$ m, $L=1,600$ m, $V_{RES}=850$ Mm³)
- Bottom outlet ($L=220$ m, $D=1.5$ m, $Q=25$ m³/s)
- Spillway ($L=48$ m, $Q=2,250$ m³/s, Gates: N°4 flap 12x8.5m)
- Power Tunnel ($L=8.8$ km, $D=5.5$ m)
- Surge Shaft ($H=110$ m, $D=14$ m)
- Underground Power House (Dimensions 83x22.5x41 m, No. 3 Francis turbines IP = 3x66,7 MW , $Q_{des}=100$ m³/s, Design head = 220 m)

Position held: Geotechnical Engineer

Activities performed: Final design, tender documents, tender supervision, Supervision of construction

BWARI Water Supply

Year: 1999 - 2002

Location: Nigeria

Client: Sarin Iniziative Industriali Spa

Main project features: Pipeline for the drinking water supply of Abuja's District includes:

- Pumping Station (Pumps N° 6, $Q = 310 \text{ l/s}$, $H = 95 \text{ m}$)
- Main Pipeline ($D = 600 \text{ mm}$, $L = 12.500 \text{ m}$, N° 5 Control Cabine)
- Distribution Pipeline ($D = 150\text{-}300 \text{ mm}$, $L = 4.65 \text{ m}$, N° 50 Use points)
- Storage Tank ($V = 12.500 \text{ m}^3$)

Position held: Geotechnical Expert

Activities performed: Final and construction design, Supervision of construction for the contractor

BUMBUNA Hydroelectric Power Plant (IP = 50 - 275 MW)

Year: 1998 – 1999, 2002

Location: Sierra Leone

Client: Ministry of Energy & Power, Republic of Sierra Leone

Main project features: Hydroelectric Plant to be constructed in 5 phases, with 275 MW in final phase. The plant currently operating, having IP = 50 MW, includes :

- Rockfill dam ($H = 88\text{m}$, $L = 44 \text{ m}$, $V_{\text{RES}} = 410 \text{ Mm}^3$)
- Multi-purpose water tunnels (No. = 2, $L = 2 \times 620 \text{ m}$, $D = 9\text{m}$)
- Spillway (No. 2 morning glory, $Q = 3000 \text{ m}^3/\text{s}$)
- Outdoor Power house (No. 2 Francis turbines, $\text{IP} = 2 \times 25 \text{ MW}$)
- Transmission line (161 kV , $L = 205 \text{ km}$)

Position held: Civil and Geotechnical Engineer

Activities performed: Assessment, Final design revision and update, Supervision of Works (Plant on Line since 2010)

BUSALLETTA Dam Upgrade and Refurbishment

Year: 1999 – 2001

Location: Italy

Client: Acquedotto Nicolay S.p.A., Genoa

Main project features: Upgrade and refurbishment of the outlet works of the existing Busalletta dam, for water supply, including :

- Refurbished Outlet Tunnel ($Q = 50 \text{ m}^3/\text{s}$, $L = 211 \text{ m}$, $D = 2.4 \text{ m}$)
- Upgraded energy dissipator ($Q = 50 \text{ m}^3/\text{s}$, ski jump type)
- Outlet Canal ($L = 40$, $W = 15 \text{ m}$)

Position held: Geotechnical Engineer

Activities performed: Final design and supervision of construction of the refurbishment and upgrade of the outlet works, Dam break studies

ARCICHIARO Dam for Multipurpose uses

Year: 1998 – 2000

Location: Italy

Client: Ente Risorse Idriche del Molise (ERIM)

Main project features: Reservoir for multipurpose uses including:

- Rockfill Dam ($H = 89.3 \text{ m}$, $L = 270 \text{ m}$, $V_{\text{RES}} = 11.1 \text{ Mm}^3$)
- Concrete Weir ($H = 29 \text{ m}$)
- Spillway ($L = 85 \text{ m}$, $Q = 447 \text{ m}^3/\text{s}$)
- Penstock ($L = 3.2 \text{ km}$)
- Access road ($L = 3.1 \text{ Km}$, Lane Width = 7.0 m , N°2 Bridges)

Position held: Hydraulic and Geotechnical Engineer for construction design.

Activities performed: Supervision of construction

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PORTO ROMANO

Year: 1998 - 2001

Location: Italy

Client: Yacht Club Tevere

Main project features: Yacht Harbour for the city of Rome along the Tevere River, about 1 km from the river mouth. The main features of the project are as follows :

- Marina for 197 berth points (boats from 10 to 25 m of length)
- Basin (Area = 26600 m², Excavation = 122.500 m³)
- Yacht Club with restaurant and sport center
- Naval Yard with slipway & boat depot

Position held: Project Manager, Geotechnical Engineer

Activities performed: Preliminary Design, Supervision of Investigations, Final Design, Tender Documents, Supervision of the Works

LIMONLU Hydroelectric Power Plants (IP = 50 / 76 MW)

Year: 1997 - 1998

Location: Turkey

Client: TGT Electric Power Construction, Ministry of Energy & Natural Resources

Main project features: Limonlu hydropower cascade comprises No. 4 plants on the Lamas River to be built in two phases (Phase 1 = 50 MW, Phase 2 = 26 MW). The works of the first phase include:

- Weir (H = 8 m, L = 40 m)
- Power Tunnels (5 km, D=3 m)
- Surge Tank (H = 16 m, D = 12 m)
- Penstocks (2 No., L tot = 3 km; D=2-1 m)
- Power Houses (2 No., Francis turbines, IP = 20 + 30 MW)
- HV Transmission Line (154 kV; L = 1.2 km)

Position held: Hydraulic and Geotechnical Engineer

Activities performed: Final Design, Tender Documents of the Phase 1 (50 MW). Preliminary design for Phase 2 (26 MW)

DANKEL Multi Purpose Project including water transfer, hydro (IP = 500 MW), port

Year: 1997 - 1998

Location: Eritrea

Client: Salini Costruttori S.p.A.; Beneficiary: Government of Eritrea

Main project features: Dankel Multipurpose Project includes:

- External port (Red Sea) and Internal port
- Canal A (L = 30 km, W = 15-50 m, H = 9 m, navigable)
- Sariga Rockfill Dam (L = 1.5 km, H = 18 m)
- Canal B (L = 23 km, W = 30-60 m, H = 9 m, navigable)
- Mendah Concrete Dam (L = 300 m, H = 22 m)
- Hydropower plant (IP = 500 MW, E = 1000 GWh)

Position held: Hydraulic and Geotechnical Engineer

Activities performed: Investigations, Master plan (preliminary project), Feasibility Study

DIRE DAM Water Supply

Year: 1997 - 1998

Location: Ethiopia

Client: Salini Costruttori S.p.A.; Beneficiary: Addis Ababa Water and Sewerage Authority

Main project features: Dam for water supply to Addis Ababa includes the following works :

- Dam (Earth Dam type, L=1,980m, H=46m, V_{RES}=19Mm³, Q=500m³/s)
 - Canal (L = 200 m, W = 40 m)
 - Intake Tower (H = 48.6 m, Steel Footbridge L = 150 m)
 - Pipeline (Pipe Diameter = 700 mm, L = 10 km)
-

TECH-6: Curriculum Vitae (CV) for Proposed Professional Staff

Position held: Hydraulic and Geotechnical Engineer

Activities performed: General review of the design, Dam stability analysis, Final design of intake works, spillway, valve chamber and footbridge

Publications:

- A. Pietrangeli, A. Brasca, S. Galantino, G. Pittalis; January 2013. "Powering on with hydro design"; International Water Power & Dam Construction; January 2013;
- Several Authors, 2010. "Sediment and sustainable use of reservoirs and river systems"; ICOLD bulletin No. 147
- G. Pietrangeli, A. Pietrangeli, A. Scuero, G. Vaschetti, 2009. "Gibe III: A zigzag geomembrane core for a 50 m high rockfill cofferdam in Ethiopia"; The 1st International Symposium on Rockfill Dams; Chengdu, CHINCOLD;
- A. Pietrangeli, I. Pallavicini, 2007; "Hydroelectric Cascade Plants in the Omo basin in Ethiopia"; CIGB ICOLD Annual Congress 2007;
- Pietrangeli A., Brasca A., Ricciardi V., 2006. "Collaudo della diga di Monte Crispu e approvvigionamento idrico della città di Bosa (Sardegna)", ITCOLD annual conference 2006
- Madau A., Bussalai S., Lazaro P., Pietrangeli A., 2006 Ampliamento del serbatoio di Macheronis", ITCOLD annual conference 2006

14. Certification:

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged.

[Signature of staff member or authorized representative of the staff] Date: _____
Day/Month/Year

Full name of authorized representative: _____