Paul C. Rizzo Associates, Inc.
CONSULTANTS

Application for Participation Under the United States Initiative on Joint Implementation

*Republic of Bulgaria
Sreden Iskar Cascade
Hydropower Development*

Prepared for:

*United States Initiative on Joint Implementation
Evaluation Panel
Washington, D.C.*

Prepared by:

*Paul C. Rizzo Associates, Inc.
Monroeville, Pennsylvania*

*November 1998
Project No. 97-1763*

DOE/EE/ 35029--T1

**REPUBLIC OF BULGARIA
SREDEN ISKAR CASCADE
HYDROPOWER DEVELOPMENT**

APPLICATION FOR PARTICIPATION

UNDER THE

**UNITED STATES INITIATIVE ON JOINT
IMPLEMENTATION**

**SUBMITTED TO:
UNITED STATES INITIATIVE ON JOINT IMPLEMENTATION
EVALUATION PANEL**

**SUBMITTED BY:
PAUL C. RIZZO ASSOCIATES**

**ON BEHALF OF:
PAUL C. RIZZO ASSOCIATES
FRONTIER 7**

NOVEMBER 1998

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Paul C. Rizzo Associates, Inc.
CONSULTANTS

November 24, 1998

Project No. 97-1763

USIJI Evaluation Panel
Attn: Mr. Chris Bordeaux
Room 4 G-036, DOE
Forrestal Building
1000 Independence Avenue, S.W.
Washington, DC 20007

**REPUBLIC OF BULGARIA
SREDEN ISKAR CASCADE
HYDROPOWER DEVELOPMENT
APPLICATION FOR PARTICIPATION
UNDER THE UNITED STATES INITIATIVE ON JOINT
IMPLEMENTATION**

Dear Mr. Bordeaux:

Paul C. Rizzo Associates is pleased to submit a formal application to the Evaluation Panel for the participation of the Sreden Iskar Cascade under the United States Initiative on Joint Implementation (USIJI).

The Sreden Iskar Cascade is a 15 MW private hydroelectric facility planned to be built on the Iskar River in Bulgaria. Each Kwh of electricity generated by this project will displace Kwh generated by fossil fuel reducing future emission of CO₂, SO₂ and NO_x.

We appreciate your consideration of our application.

Sincerely,

Paul C. Rizzo Associates

Paul C. Rizzo
President

RRB/daz
Attachment

r1-trans-1763/98

EXPO MART, SUITE 270-E, MONROEVILLE, PA 15146
PHONE (412) 856-9700 FAX (412) 856-9749

COLUMBUS, OH

MT. PLEASANT, SC

BUENOS AIRES, ARGENTINA

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I. Participants in the Project

A. Domestic

Paul C. Rizzo Associates, Inc.
Suite 270E, Expo Mart
105 Mall Boulevard
Monroeville, PA 15146

Officer responsible for the project:

Robert R. Bennett
Vice President of Operations
Telephone: (412) 856-9700
Fax: (412) 856-9749

Category of Eligibility: Company recognized by the laws of the State of Pennsylvania.

Legal proof of eligibility: 25-1463856

Corporate Description: Paul C. Rizzo Associates, Inc., is an engineering and power development company dedicated to providing comprehensive services in the areas of power project development, design, environmental assessment, geotechnical evaluation and construction management on an international basis.

B. Foreign

Frontier 7 plc
9, Fridtjof Nansen Boulevard
Sofia 1000, Bulgaria

Officer responsible for the project:

George Sotirov
Executive Director
Telephone: + 3592-980-9060
Fax: + 3592-800-306

Country of Incorporation: Republic of Bulgaria

Category of Incorporation: Company recognized by the laws of the host country.

Legal proof of eligibility:

Corporate description: Frontier 7, is a Bulgarian company that provides energy and environmental services to Bulgaria.

II. Project Information

A. Description and Milestones

1. Brief Summary of the Project

Electricity generation in Bulgaria is a mix of thermal (53%), Nuclear (31%) and hydroelectric (16%) with a total capacity of 12,150 MW. This generation accounts for approximately 40% of the Country's needs with the remaining 60% purchased from Turkey and the Ukraine.

Interest in water resources and hydropower has been low in Bulgaria for over 20 years and only about 33% of the potential hydropower available to the Country are currently being utilized. This is due in part to past design practices that utilized large reservoirs to regulate runoff and create the necessary head. The Iskar River does not allow for the typical design. However, in recent years, technical advancement in machinery design and more efficient turbine-generators has lead to the development of low-head hydro projects. Studies determined that the Iskar Cascade can support low-head hydro development and could provide as much as 93 MW of capacity.

This project will initially consist of the construction of three hydroelectric facilities along a 120-km section of the Iskar River in western Bulgaria. Each facility will consist of a powerhouse (housing a turbine and generator), an embankment dam, a concrete spillway with regulating gates, a fish passage, and associated transformers and switchgear. Potentially, as many as 37 additional similar plants could be constructed along the Iskar Cascade. The operation and maintenance of the facilities will be through the applicants.

The Project has been designed to standardize the plants and minimize costs to enhance financial feasibility. Appendices provide the financial analysis, cost analysis, and design drawings for each of the three plants:

- Appendix 1 - Bov-North Project
- Appendix 2 - Prokopanic Project
- Appendix 3 - Svrazhen Project

2. Location of the Project

The Sreden Iskar Cascade Project is a hydropower development project that will be located in western Bulgaria along a 120-km section of the Iskar River. The Iskar River is one of the longest in Bulgaria having a length of approximately 363.8 km, a displacement of 2414 meters and a catchment area of 8366 km².

Three low-head projects will be constructed in the section of the river between the towns of Novi Iskar, approximately 11 km north of Sofia and Cherven Briag downstream. A map of the project location is attached as Appendix 7.

3. Greenhouse Gas Sources and Sinks

The greenhouse benefits of the proposed project will be in the displacement of electricity that would be produced by coal burning thermal generation.

Base on 1991 data, Bulgaria has a total generating capacity of approximately 12,150 MW and provides approximately 40% of the Countries requirements. The generation is a mix of thermal (53%), nuclear (31%) and hydro (16%). The additional power needs are met through the purchase of electricity from Turkey and the Ukraine.

The generating plants are located throughout Bulgaria and the thermal plants burn local indigenous coal and emit an estimated 52 million metric tons of CO₂ annually. With this hydropower development project, the carbon dioxide emissions will be reduced by 116,950 metric tons per year. In the future, with the addition of the other thirty-seven facilities, the CO₂ reduction could be as much

as 752,764 metric tons per year. This represents a reduction of 0.2 to 1.5 percent of carbon dioxide from the 1991 emissions level.

4. Measures to Reduce Greenhouse Gases

The power plants of the Sreden Iskar Cascade development are an ecologically clean and recoverable energy source. They will be an alternative electric energy source that will offset the equivalent electric generation of thermal power plants burning indigenous coal. The net annual effect will be the reduction of sulfuric oxides by approximately 14,000 metric tons, eliminating 500 metric tons of ash produced, and saving 200 hectares of first class arable lands. Over the estimated 50 year life of the project, it is estimated that 0.7 million metric tons of sulfuric oxides and 23,000 metric tons of ash will be eliminated. Also, over 13 million metric tons of lignite will be saved.

5. Dates of Significant Milestones

May 1995 - Electrowatt Engineering completes Bulgaria Hydropower Study for the World Bank establishing the potential to develop the Iskar Cascade.

January 1998 - Nazionalna Electricheska Compania prepares project description for the Sreden Iskar Cascade identifying overnight capital cost as \$1600 per Kw of capacity installed.

March 1998 - Frontier 7 completes a prefeasibility study on the Sreden Iskar Cascade concluding that the project will not have a negative impact on the already disturbed ecology.

November 1998 - Paul C. Rizzo Associates completes feasibility study demonstrating an overnight capital cost ranging from \$909 to \$1010 per KW installed.

March 1999 - Financing activities to complete the plant will begin.

September 1999 - Financing arrangements are planned to be completed.

Spring 2000 - Civil construction begins.

Fall 2001 - First unit begins operation.

5.e Lifetime of the Project

The project is expected to have a 50-year life or greater with the useful life of the equipment expected to be in excess of 20 years.

B. Sources of Funding for the Specific Measures to Reduce Greenhouse Gas Emissions

1. Project Funding Sources

The total capital cost of the project is estimated to be approximately \$14.1 million (all cost figures quoted here are in 1998 US dollars). This estimate includes (i) facility costs associated with the actual physical plant and equipment, and (ii) non-facility costs, such as legal and financing costs associated with project development.

Of the \$14.1 million project costs, the following entities shall contribute cash equity, or loans:

2. Multilateral Funding Sources

US EXIM or EBRD loans totaling \$4.5 million.

3. Federal Funding Sources

Not Applicable – There is no federal funding involved in this project.

4. Equipment Supplies

Equipment suppliers will provide export credit loans of \$4.0 million.

5. Private Sector

Private sector investment from Paul C. Rizzo Associates, Frontier 7 and other investment sources will provide \$5.6 million of cash equity. At this level of equity, Paul C. Rizzo Associates estimates that two of the three projects are financeable. The third project (Prokopanic) will require further optimization after experience is gained in constructing the other two plants. The financial overview of each plant is given below.

PLANT	CAPITAL COST \$K	EQUITY	TOTAL COST (\$K)	RATE OF RETURN, %	INSTALLED CAPACITY, KW
Bov-North	1,010	1,823	4,557	20.1	4,490
Prokopanic	909	1,895	4,738	13.7	5,172
Svrazhen	915	1,930	4,826	17.0	5,226
Total	942	5,648	14,121		14,888

C. Assignment of Emissions Reductions

The anticipated assignment of all carbon emissions reductions or credit will be apportioned amongst the project equity participants based on equity share.

D. Additionality

1. Previous studies and designs for the project identified that the capital cost to be \$1,600 per Kw of capacity installed. At this cost the project is not financially feasible. The USIJI funding allowed a redesign of the plants to be completed to optimize the costs. As a result, the capital costs are lowered to under \$1,000/Kw on average. At this level, the plants are in the range of financial feasibility even though at least 40 percent equity is expected to be required to obtain financing. This project will reduce the need to expand generation capacity by fossil fired power plants.
2. In 1998, Bulgaria has established a new comprehensive energy law that promotes energy efficiency and environmental projects. The laws and regulations establish a framework for independent power generation that allows such projects as the Sreden Iskar Cascade to be economically and commercially feasible.
3. Prevailing practices of clean air compliance in Bulgaria is limited. There are, however, a number of projects underway in Bulgaria to modernize fossil fired generation facilities to reduce emissions and upgrade emission control equipment. Hydroelectric power eliminates emissions not just control them.

E. Acceptance by the National or Federal Government of the Host Country

In addition, a letter from the Ministry of Environment is attached as Appendix 6. The attached letter to Paul C. Rizzo Associates, Inc. from the Manager of the Hydropower Division of Energoproekt plc, Peter Petrov, demonstrates that as a host country, Bulgaria strongly supports the Sreden Iskar Cascade application.

F. Technical Assistance

At the present time it is not anticipated that technical assistance from the USIJI will be required for the Sreden Iskar Cascade project, however, the parties would like to reserve the benefit of such assistance if required.

III. Greenhouse Gas Emissions and Sequestration

A. Baseline Estimate of Emissions and/or Sequestration of Greenhouse Gases Without Measures

Methodologies for Emission Estimates

A CO₂ reduction factor was calculated for the project based on combustion of low-BTU lignite coal at the Maritza East thermal generating station. The reduction factor was determined to be 1.4 kg of CO₂ for each kWh generated. Using the reduction factor, total thermal generation of 6440 MW, and an operating efficiency of approximately 66 percent for all the plants. The total CO₂ emission C production was calculated using the following equations:

$$(6440 \text{ MW})(1.4 \text{ kg CO}_2 / \text{kWh})(8760 \text{ hr/yr})(0.66 \text{ efficiency}) = 52.1 \text{ million mt CO}_2 / \text{year emitted}$$

$$(52.1 \text{ million metric tons CO}_2)(1 \text{ metric ton C} / 3.66 \text{ metric tons CO}_2) = 14.2 \text{ million mt C / year}$$

Based on this information, baseline CO₂ emissions are 52.1 million metric tons per year and baseline C production is 14.2 million metric tons per year.

Projected CO₂ emissions in the year 2001 are expected to be 52.2 million metric tons annually and remain the same through the year 2020. The C production will also remain the same at 14.2 million metric tons through the year 2020.

B. Estimates of Emissions and Sequestration of Greenhouse Gases With Measures

Methodologies for Emission Estimates

When the Sreden Iskar Cascade projects begin generation, the amount of baseline CO₂ emission will be reduced 1.4 kg for each kWh of generation.

The amount of CO₂ and C reduction for the projects estimated at 14.9 MW of generation is calculated as:

$$(14.9 \text{ MW})(1.4 \text{ Kg CO}_2/\text{Kwh})(8760 \text{ hrs/year})(0.64 \text{ eff}) = 116,950 \text{ mt CO}_2/\text{year emitted}$$

$$(116,950 \text{ metric tons CO}_2)(1 \text{ metric ton C}/3.66 \text{ metric tons CO}_2) = 31,953 \text{ mt C/year}$$

Based on this information, the annual CO₂ reduction will be 116,950 metric tons per year and the C reduction will be 31,953 metric tons per year.

These reductions would remain constant through the life of the project to year 2020. If additional plants were added, the reduction would increase.

C. Monitoring Greenhouse Gas Emissions and Updating Emissions Estimates

1. Parties responsible for monitoring will be the operator of each power project.
2. Monitoring of the emission reductions will be done by the measurement of the kWh generated by the project.
3. Verification of the greenhouse gas reduction will be done by auditing the official generation records.
4. Proposed schedule for monitoring activities.

5. Describe how monitoring data will be used to update the baseline data.

D. External Verification

1. The participants in this project agree to independent, external verification of the information presented in this proposal. The participants welcome inspection by qualified third parties to review the appropriateness of the methodologies used to determine emissions reductions prior to construction.
2. In the post-construction period, the participants will provide, in writing, a certified record of the actual generation transmitted to the electricity grid as recorded at the point of sale.

IV. Other Considerations

A. Non-greenhouse Gas Environmental Impacts of the Project

The region along the Sreden Iskar Cascade, in the area of the project facilities, has a well-developed infrastructure. There are main roads, railways, and short access roads that facilitate access to each site. Connection of the facilities to the power grid will be done through short connections with existing facilities along the river.

Utilization of the water from this area of the river has no universal character and therefore, interference by other water consumers, with this project, is unlikely.

B. Development Impacts of the Project

Construction of each facility is estimated to 1 to 2 years with multiple facilities in construction simultaneously.

Sources of materials for the majority of the site construction are nearby. A number of stone quarries are located in the Iskar defile as well as sand and aggregate suitable for the production of concrete. The excavations from the main structures will be used as much as possible to construct the embankments and fill areas. Precast concrete and steel products can be manufactured in plants in Sofia, cement from Vratza and reinforcing steel from Pernik.

The construction of these power plants will create jobs for approximately 300 qualified personnel for a period of two or more years. When the construction is completed, jobs will be created for persons with specialties to operate the power plants. Persons to perform the construction and operation jobs are readily available from the region.

Presently the section of the Iskar River, between Novi Iskar and Cherven Briag, is heavily polluted and therefore, the construction activities will not have a negative impact on the already disturbed ecological harmony of the existing river biota.

C. Efforts to Reduce Domestic Greenhouse Gas Emissions by U.S. Participants

Paul C. Rizzo Associates is active in reducing greenhouse emissions. As a company, it has continued to develop hydroelectric facilities both in the United States and elsewhere. To date, it operates a 12 MW facility and additional projects totaling in excess of 100 MW are under development.

In conjunction with a domestic utility, Paul C. Rizzo Associates is developing projects that utilize landfill gas to generate electricity resulting in a significant reduction of emissions. In excess of 100 MW of such plants are planned to be completed by year 2002.

D. Other Information for the Panel to Consider

For more than 20 years, Bulgaria has overlooked an ecologically clean, renewable alternative energy source, water and hydroelectric power. Full utilization of the countries hydroelectric potential could reduce or eliminate energy dependence on import of foreign power.

In addition to the greenhouse gas emission reductions noted earlier in this application, a reduction of approximately 14,000 metric tons of sulfuric oxides could be prevented. Also, 500 or more metric tons of ash would not be produced and 200 hectares of first class arable lands would be saved.

Reduction or elimination of energy imports from Turkey and the Ukraine would also reduce greenhouse gas emissions in those countries as well.

Successful implementation of relatively low cost hydroelectric facilities through commercial financing mechanisms sets a model that can be replicated in other countries with potential hydroelectric resources.

Sreden Iskar Cascade Project CO2 Emission Reduction

APPENDIX 1

BOV-NORTH PROJECT DETAILS

N

SECTION A-A

SECTION B-B

Budget
Removed.

APPENDIX 2

PROKOPANIC PROJECT DETAILS

PLAN
PROKOPANIK
DWG PROKI

N

ROCK ANCHORS 2m O/C (TYP) EACH
DIRECTION IN POWERHOUSE AND
SPILLWAY AREA

budget removed.

APPENDIX 3

SVRAZHEN PROJECT DETAILS

PLAN
SVRAZHEN
DWG SVRA1

PLAN
SVRAZHEN
DWG SVRA2

SECTION B-B

budget
removed.

APPENDIX 4

PARTICIPATION CERTIFICATION SIGNATURES

**U.S. INITIATIVE ON JOINT IMPLEMENTATION
CERTIFICATION STATEMENT OF PROJECT PARTICIPANTS**

We, the undersigned, have each reviewed the proposal as submitted and to the best of our knowledge and belief, certify that all information provided therein is accurate and complete. Further, the undersigned acknowledge that they have read and understand the general provisions of the guidelines for a USIJI project proposal and agree to comply therewith.

Paul C. Rizzo, President
Paul C. Rizzo Associates

**U.S. INITIATIVE ON JOINT IMPLEMENTATION
CERTIFICATION STATEMENT OF PROJECT PARTICIPANTS**

We, the undersigned, have each reviewed the proposal as submitted and to the best of our knowledge and belief, certify that all information provided therein is accurate and complete. Further, the undersigned acknowledge that they have read and understand the general provisions of the guidelines for a USIJI project proposal and agree to comply therewith.

George Sotirov, Executive Director
Frontier 7

tl-app4-1763/98

APPENDIX 5

CERTIFICATION LETTERS

ENERGOPROEKT - PLC
HYDROPOWER DIVISION

Power Consulting Engineers

51 James Bourchier Blvd. 1407 Sofia, Bulgaria
Tel.: (+3592) 665 408, (+3592) 687 350
Fax: (+3592) 665 249, Telex 22219ENPRO BG
E-mail: hkk@enpro.bg

Mr. Robert Bennett
Vice President, Operations
Paul C. Rizzo Associates, Inc.
105 Mail Boulevard, Suite 270-E
Monroeville, PA 15146-2347
USA

23 July 1997

Subject: Proposal for Support of the Development of the Sreden Iskar Cascade

Dear Mr. Bennett:

The Hydropower Division of Energoproekt plc has been assigned by Mr. Lazarov, Secretary General of the Committee of Energy of Republic of Bulgaria, to review the project that Paul C. Rizzo Associates in partnership with Frontier 7 proposed for submittal to the United States Department of Energy for support of the development and implementation of international projects that reduce, avoid, or sequester gas emissions under the USIJI program.

Energoproekt plc is Power Consulting Engineering Organization licensed by the Bulgarian government to carry-out the design and construction supervision of major power projects. The Hydropower Division is one of the founders of Energoproekt plc and is specialized in consultancy in the area of water resources. All existing studies of the Sreden Iskar Cascade have been prepared by the Hydropower Division of Energoproekt.

We are pleased that the Paul C. Rizzo Associates / Frontier 7 proposal focuses on the reality of implementation and that it is aimed at making Bulgarian entities capable of developing these projects with your support. Implementation depends on bringing financing and investment to Bulgaria and the project makes a major step toward the objective. As such, this is a major step forward since it has moved beyond technical feasibility into financial feasibility.

Development of small hydroelectric stations is fully consistent with Bulgaria's policy regarding

reducing greenhouse gas emissions as well as the nation's current energy development strategy. You can count on our full support regarding this project and will be pleased to co-operate with you during its implementation.

Please feel free to share this letter with the United States Department of Energy or USIJI.

Yours sincerely,

Peter Petrov
Manager of the Hydropower Division of Energoproekt plc

APPENDIX 6

LETTER FROM BULGARIAN MINISTRY OF GOVERNMENT “HOST COUNTRY ACCEPTANCE LETTER”

TO BE PROVIDED AT A LATER DATE

APPENDIX 7

PROJECT LOCATION MAP

SREDEN (MIDDLE) ISKAR HYDROPOWER DEVELOPMENT SCHEME

GENERAL LAYOUT OF THE SCHEME

NOTE:

1 Rebrovo	11 Balkan - North	23 Ruzhanska	33 Gara Otlen
2 Thompson	12 Lakaclink	24 Zverino - East	36 Sinyo Bordo
3 Prokoponik	13 Lakaclink - 1	25 Zverino - North	37 Strupets
46 Svoge - South	14 Swazhen - South	26 Cherepish - 1	38 Roman
49 Svoge	15 Swazhen - North	27 Cherepish - 2	39 Gara Roman
56 Svoge - North	16 Opletinya - 1	28 Lulibrod	40 Radovene
59 Zelen	17 Opletinya - 2	29 Lulibrod - East	41 Kurlino
6 Tserovo - South	18 Opletinya - 3	30 Rebarakovo	42 Korlukovo - 1
76 Tserovo - North	19 Gabrovnik	31 Rebarakovo - East	43 Korlukovo - 2
79 Treskavets	20 Elishevo - West	32 Mezdra - South	44 Reselets - South
8 Bov - South	21 Gara Elishevo	33 Reselets	45 Cherven Bryag
9 Bov - North	22 Elishevo - East		
10 Balkan - South			