

**THE GEOLOGICAL AND HYDROGEOLOGICAL SETTING PREVAILING ALONG  
THE PROPOSED 92 MILES LONG GAS PIPELINE  
FOR CENTRAL AND NORTH- CENTRAL PUERTO RICO**

AN ADVERSE UNDERTAKING ALONG ITS ENTIRE TRAYECTORY

**OVERVIEW:**

We have proceeded in studying the alleged Environmental Impact Statement (EIS), both preliminary and final, for this project and the included maps defining the trajectory to be followed by the proposed gas pipeline. Needless to say that we were highly surprised before the scientific indifference and ignorance contained in said public document, specially the laxitud, lack of serious analysis, and the inhuman callowness that this project harbor as a whole; for example:

--We understand that the gas pipeline project is unnecessary and with it the people of Puerto Rico will be subsidizing the creation of an eventual monopoly in the supply and distribution of natural gas, in favor of ECO-ELECTRICA; a firm based in Spain with a long sad history of abusive action in Central America where it has penetrated.

--The geologic and hydrogeology description of the 92 miles route (150 kilometers long) included in the EIS is a superficial effort secured from an office desk and the descriptions an accounts obtained from the U.S.G.S, Geologic Map (Scale 1:20,000). It is not a product obtained from field work and methodological accounts and considerations of the existing rough topography and the complex and seismically active geological setting to be traversed by the proposed pipeline. The EIS does not offer profiles of the difficult topographical section and does not elaborate as to the intricate hydrogeology to be intercepted. Neither does it provide accounts of the rather unstable formations and conditions that will be encounter in the crossing, nor of the methods or provisions, to be implemented, to assure stability within the landslide and subsidence-prone region of high topographical relief.

--In all, it is in order to mention the following important considerations and factors which are completely ignored in the EIS prepared by the Electrical Energy Authority of Puerto Rico (AEE in Spanish). Due to its importance the adverse impact of the proposed crossing upon the numerous alluvial flood-prone plains, to be spanned by the project, it treated here under a mayor tittle. But attention is called upon the following adverse impact to be inflicted:

- a) The pipeline to be emplaced intercepts forty five (45) geologic formations and units of variable lithic competence some of which are highly susceptible to erosional and translational problems.

The EIS does not evaluate the complexity or seriousness of this geologic setting in the preliminary document nor was it considered in the final EIS which was published with the same scope and concept even though the hundreds of documents and articles extended or provided, by economists, environmental engineers, scholars and common citizens against this project and its trajectory. None of which was seriously considered.

- b) The trajectory of the pipeline climbs extraordinary topographical relief of 25 to 30 degree slopes within five (5) miles of mountainous terrain from the base of the Central cordillera, along the southern approach, to the upper reaches of this mountain chain. The required trenches for its emplacement will require interventions in the Juana Diaz Formation, in numerous ancient landslide and saprolitic deposits and also in landslide and rock fall –prone steep slopes.
- c) Along its central north-bound route the pipeline will intercept additional formation very susceptible to land sliding such as de San Sebastian and Cibao formations just before entering the karst region north of Utuado. And, as it progresses along highly developed karst terrain of the northern limestone units, limestone (haystacks) hills, sinkholes and surfaces, prone to subsidence and collapses, will be intercepted along this unpredictable terrain.
- d) A major concern is the fact that the gas pipeline will be also crossing and intercepting 87 bodies of water along its zig-zagging route. Some of these bodies consist of juvenile scouring brooks and creeks which occupies steep slopes. Other water bodies along the path consist of major rivers and their respective flood plains as well as stranded oxbow lakes, ponds and swampland.
- e) Altogether the pipeline will be crossing or traversing some 63 secondary and principal roads seven of which are considered main primary or express way. Of concern is a sector of highway PR-10 between Arecibo and Utuado where the gas pipeline is to be emplaced, for several kilometers, along the shoulder of said highway. This is a sector that has experienced numerous landslides in the past that has prompted the closing sector of this road in several occasions. It is here where the unstable San Sebastian formation was intercepted by this road, and it is to serve as the path for the pipeline in its route to the northern reaches of the Island.

## **IMPORTANT CONSIDERACION AND EVALUATION REGARDING ADVERSE IMPACT TO BE INFLICTED BY THE PROPOSED PIPELINE UPON ALLUVIAL PLAINS OF MAYOR MEANDERING RIVERS, FLOODABLE RIVER VALLIES AND SWAMP LAND**

### **OTHER CONSIDERATION**

Puerto Rico is only 35 miles wide and slightly over 100 miles long. It is one of the most density populated country in the world with over one thousand persons per square miles.

The proposed pipeline will stretch 92 miles (150 kilometers) covering the entire width of the Island (north-south) and prolonging itself along the central coastal reaches; from the city of Arecibo to the vicinity of San Juan, where the main generating capacity of the island are located and are to be served by the gas main.

This selected route for a proposed gas pipeline not only stretches over high-relief and geologically complex terrain but it certainly shall become an oppressive and unnecessary undertaking. Many communities will be impacted, both physically and psychologically and the population will end-up paying a tag of over one billion dollars. The proposed uncomfortable trajectory is also un-called for when the main port facilities at San Juan are, at the most, only 4 miles east of the generating plants to be served.

The technical and scientific community of Puerto Rico that has taken the time and diligence to analyze the proposed pipeline route is in agreement that the benefits to be derived from such project are nil and that the construction operation and maintenance of such out weights by far any alleged benefit to consumers. The promoters of this project have shown no interest in considering more economically and environmentally friendly alternatives.

In the following paragraph a brief but important physiographic description created by the geological and hydrogeological setting prevailing along the proposed path is described. The accompanying maps illustrating the proposed trajectory of the gas pipeline, intersecting and crossing the length of floodable river vallies, is one of the main concern exposed in the present analysis.

Before me proceed with the analysis it is pertinent to note that the watersheds of the main rivers here mentioned are located or bounded by relatively steep terrain. Consequently, under intense tropical storm conditions strong hydrodynamic surges

often overwhelms these coastal flood plains that are to harbor significant stretches of the proposed pipeline. Very often roads and bridges, spanning water bodies in these plains, are undermined, cripple or washed-away. These meandering rivers change courses and abandon their channels under strong discharge, thus, marshland and oxbow lakes dots these alluvial plains.

Along its initial 30 miles long trajectory rather steep slopes, of 20 and 30 degrees of inclination, will be intercepted. The E.I.S. does not provide profiles nor explanations of how the strong relief prevailing along the Central Cordillera will be approached or the pipeline secured.

The above is of utmost importance due to the fact that the base of this mountainous region is dotted with ancient landslides deposits and weak saprolitic surfaces very susceptible to be undermined by downward scouring movements propense to be reactivated once the interventions are initiated. Also, very limited space is available at these mountainous approaches for adequate or proper maneuver of heavy machinery and safeguards. Thus, the surface area to be intervene will have be considerably greater than the restricted one mentioned in the EIS.

Since 300 acres of wetland will be impacted as well as the highly mineralized terrain at the plutonic stock region of Adjuntas and Utuado in Central Puerto Rico. earthwork along these terrains will certainly create sedimentation and drainage problem as well as the exposure of existing primary copper minerals to rapid lixiviation processes. The E.I.S. does not touch these potential problems although a mayor watershed and water supply installations are located along the path of the proposed pipeline project.

#### **SPECIAL OR PARTICULAR COMMENTS REGARDING THE EXTRAORDINARY ADVERSE IMPACT OF THE PROPOSED PIPELINE CROSSING OF THE PRINCIPAL HYDROGRAPHIC ZONES OF NORTH-CENTRAL PUERTO RICO**

In the following paragraphs a brief outline of the damaging course conceived (for the gas pipeline) that also is to be emplaced across seven (7) mayor rivers and their flood plains. There is no doubt that this ill-conceived emplacement respond to economic conveniences for potential contractors and not to a scientifically selected or well-advised venture.

Following the proposed trajectory, starting in the southern costal fringes of the Tallaboa River Valley and the ECO-Electrical firm facilities and continuing its northward trend, we have the following adverse crossing in the these hydrogeological settings.

### **Tallaboa River Valley**

An erratic crossing along the length of this valley is proposed for the initial southern course of the pipeline project at the ECO-ELECTRICA facilities. Strong hydrodynamic floods and flows are recurrent in this valley due to the steep topographic slopes harboring its watershed. (See plate No. 1)

Thus the pipeline will be subject to strong undermining and erosional flood currents.

### **The Arecibo River and Flood Plain**

After crossing the central mountain chain and its numerous geologic formations and steep slopes the pipeline will be entrenched along the shoulder of highway PR-10, then it will enter and traverse practically the entire length of the extensive flood plain of the Arecibo River.

The Arecibo River is dammed before it enters the karst region of northern Puerto Rico but the dam is not a flood control structure. Thus the zig-zagging trajectory of the pipeline which will be emplaced along the entire length of the sandy floor of this valley, will be intersecting the river channel and existing oxbow lakes several times.

The sandy nature of the valley floor is highly erosive and the river is of a meandering nature, thus, the entire section of the pipeline is susceptible to be undermined and/or displaced during extraordinary flood conditions which are recurrent in this hydrographic system of high annual precipitation. Creeks, oxbow lakes and the main river channel will be intercepted within the valley realm. This crossing in particular is of an unpredictable and unreliable nature. (See plate No. 4).

### **The Manati River and Flood Plain**

After leaving the Arecibo River Valley the projected westward direction of the pipeline will bring it across well-developed karst topography and into the often flooded Manatí River Valley where this meandering River will be also intercepted. This is also a wide flood-prone valley close to sea level and dotted with marsh land and oxbow lakes. There is no flood control dams or system within this hydrographic region, thus the hydrodynamic that develops along the lower reaches of this water shed are extraordinary. The pipeline will be receiving the full impact of said dynamic flow along the entire width of the crossing. Highly travelled road stretches very close to the path of the proposed pipeline along this often changing river course. (See plate No. 4)

### **The Cibuco River and Indio River and Flood Plain**

From the Manatí River valley the pipeline will be deviated slightly southward to follow highly developed karst terrain and sub-urban areas intercepting the Cibuco and Indio River which merges as a tributary in a common and narrow flood plain. These rivers are meandering ones with often-changing channels. The pipeline will be crossing, at several points, these variable and unpredictable meanders and channel course making it prone to frequent damages and/or annihilation. (See plate No. 5.)

### **La Plata Rivera and Flood Plain**

This dammed river has a wide flood plain which is subject to frequent flooding that plays havoc with existing infrastructure. The dam was erroneously located in the lower reaches of the river system with no flood control gates system. Often the town of Toa Baja is affected by flood waters as well as other infrastructures lying in the northern region of the dam. Extensive erosive action, both along the valley as well as in the coastal reaches have ensued since the dam was erected.

The pipeline will be crossing the entire breadth of the central and northern sectors of this flood plain. Ample areas of marsh land and swamps will be impacted. It should also (must) be mentioned the presence of densely populated communities close to the trajectory of the line within this section as well as strong daily traffic of vehicles between points 81 thru 87 of the lineation. This stretch is also affected by strong beach erosion and breaking waves during high tides. The original beach has lost approximately 150 feet during the past 25 years and now the existing infrastructure is protected with armor rock.

### **Rio Bayamón and this Densely Populated Flood Plain and Coastal Reach**

Ample marshes and swampland are harbored within one of the biggest alluvial and flood-prone plain to be impacted along the last lapses of the trajectory of the tube. Close proximity to urban populated areas and to a strongly receding beach front characterizes this sector of the proposed path. This crossing represents the most oppressive and dangerous of all due to high concentration of population and traffic. The lack of engineering and scientific research and meditation based on contributions from scholars and the population in general, characterizes this project which is hereby very well illustrated upon analyzing plate. No. 6.

**Conclusion:**

To conclude, we must assert that the construction cost (not including the corrupt bails and payments to political figures) maintenance, emergency repairs, and eventual relocation of sections of the proposed gas pipeline will cost the people of Puerto Rico an estimate of over a billion dollars (\$1 billion) during the first year of operation; a cost which our weak and declining economy cannot afford.

The port of San Juan can very well handle natural gas shipment and storage for the two plants existing close to said port facilities. Why destroy or obliterate a 92 miles long stretch of highly sensitive geological setting to accomplish something which can be provided with an alternative which is more logical, less expensive, ecologically an environmentally friendly and above all more humane.

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