January 29, 1999

To: State of North Dakota
The Industrial Commission
State Capitol
Bismarck, North Dakota 58505
Attn: Lignite Research Program

Subject: Application for a Grant for Partial Funding of TRI Variable Speed Fluid Drives for Induced Draft Fans at the Leland Olds Station, Basin Electric Power Cooperative.

Dear Ms. Karlene Fine:

The purpose of this Transmittal Letter is to provide a binding commitment on the part of the Applicant to complete the project as described in the application, if the Commission makes the Grant as requested.

Applicant: Leland Olds Station,
Basin Electric Power Cooperative
3901 Hwy. 200A
Stanton, ND 58571

Sincerely yours,
Leland Olds Station
Basin Electric Power Cooperative

FRStern

Fred R. Stern
Plant Manager
(Authorized to contract on the part of the Applicant)

January 29, 1999

Karlene Fine, Executive Director
North Dakota Industrial Commission
600 East Boulevard
Bismarck, ND 58505

Subject: Application for a Grant for Partial Funding of TRI Variable Speed Fluid Drives for Induced Draft Fans at the Leland Olds Station, Basin Electric Power Cooperative.

Dear Ms. Karlene Fine:

Attached please find an Application for the subject Grant. The Application is intended to meet each of the items described in Chapter 43-03-04.

The Primary Applicant is:

Leland Olds Station
Basin Electric Power Cooperative
Stanton, ND 58571
Mr. Fred Stern, Plant Manager

In the Application Documents, Turbo Research, Inc. has made certain commitments which would obligate TRI to use North Dakota steel fabricators and machining facilities and other North Dakota sub-vendors, should a Grant and Contract result from this Application. In this context, TRI might be considered to be a Sub-Applicant. This is addressed further in the attached Transmittal Letters, Section 1.

Enclosed please find a TRI check for $100.00 made payable to the State of North Dakota.

Should you wish additional information, please do not hesitate to contact either Mr. Fred Stern, or myself.

Sincerely yours,
TRI Transmission and Bearing Corp.

Melbourne F. Giberson

Melbourne F. Giberson, Ph.D.,P.E.
President

Engineering Services and Products for Large Rotating Machinery
P.O. Box 454 212 Welsh Pool Rd. Lionville, PA 19353-0454 Tel:610-363-8570 Fax:610-524-6326 E-mail: sales@turboresearch.com www.turboresearch.com

2.1. Project Title:

Demonstration Project to Show that the Installation of Variable Speed Fluid Drives on Induced Draft Fans Will Reduce Emissions Including CO2 per Kw-hr Generated, Will Improve Plant Overall Average Efficiency (Heat Rate), and Will Reduce Plant Operating and Maintenance Costs.

2.2. Applicant: Leland Olds Station

Basin Electric Power Cooperative

3901 Hwy. 200 A

Stanton, ND 58571

2.3. Sub-Applicant: TRI Transmission & Bearing Corp.
Division of Turbo Research, Inc.

P.O. Box 454

Lionville, PA, 19353

2.4. Principal Investigator:
Melbourne F. Giberson, Ph.D., P.E.

President, TRI Transmission & Bearing Corp.
and Turbo Research, Inc.

2.5. Date of Application: January 29, 1999

2.6. Amount of Request: $ 180,000.

TRI Variable Speed Fluid Drives for Induced Draft Fans at the Leland Olds Station, Basin Electric Power Cooperative.

4.1. Objectives of this Demonstration Project:

The Induced Draft (ID) Fans at the Leland Olds Station are constant speed motor drive, and use variable pitch dampers to vary the air flow through the boiler, to vary the air pressure within the boiler, and simultaneously, to vary the flow of the products of combustion (flue gas) through the air pollution control equipment downstream of the boiler.

The primary objective of this project is to confirm that introduction of a suitably designed variable speed fluid drive (VSFD) between each motor and ID fan will help to meet the following objectives for variable load operation: reduce emissions including CO_2, increase plant overall efficiency (heat rate), and reduce fan maintenance.

Additionally, with the original equipment at the Leland Olds Station, at low loads, the high differential pressure across the dampers of the ID Fans causes difficulty in operating the dampers at certain times. The use of VSFD would eliminate this problem. Some design change is highly desirable, either higher torque damper controllers, or variable speed fluid drives, one per fan, total two.

4.2. Duration: 9 mo (6 mo manufacturing, 1 mo installation, 1 mo testing, 1 mo report).

4.3. Total Project Cost: $ 384,000.

4.4. Principal Participants:

Leland Olds Plant Engineering Staff	- Manage Project, Perform Plant Engineering and Installation Work
TRI Transmission & Bearing Corp.	- Design, Manufacture Fluid Drives, Technical Direction for Installation

5.1. Explanation of the Primary Objective of this Demonstration Project:

Almost all of the major power plants in the US, including those in North Dakota, were designed and built for "base load" operation, that is, operation at or near full MW load generation. Most of these units were designed to be highly efficient in the high load range, and not at reduced MW loads. While some units are operated only as base load units today, an increasing number of these units are being used in variable load operation. With the current trend in electric utility management toward separation of the generation function from the transmission and distribution function, it is increasingly likely that more large units will be required to operate as "variable load operation" units. The important point here is that the units operating as variable load units will be evaluated on operating costs at low loads, not just at the single point of full load. For these units which will be operated as variable load units, the plant equipment design should be changed to improve operating efficiency at all loads including low MW loads.

The Leland Olds Station is operated as a variable load station; it does not operate at full load all of the time. Unit 2 is the larger unit, with maximum capacity of approximately 400 net MW. Consequently, the equipment of this plant should be designed so that is as efficient as possible over the entire normal operating range for how it is now used. A major step toward achieving this goal would be to install VSFD, rather than the existing constant speed drives, for all of the high power fans and pumps. For this project, only the ID Fans are addressed.

The primary objective of this demonstration project is to confirm that introduction of a suitably designed VSFD between each motor and ID Fan at the Leland Olds Station will help to meet the following objectives for variable MW load operation, particularly at low MW loads:

- Reduce stack emissions including CO2,

- Increase plant overall efficiency (heat rate), i.e., improve the efficiency of coal combustion, and

- Increase unit reliability by reducing fan maintenance.

For example, at minimum MW generation load, the electric power draw for an induction motor for a constant speed ID fan is approximately 40% to 50% of full load power consumption for that motor, whereas with a variable speed fluid drive, the power draw at minimum MW generation load approaches the power draw when the motor is un-coupled, on the order of 5% to 15% of full load motor power, depending upon the motor design.

With the power demand on the auxiliary electric supply system in the plant reduced more at low loads than at high loads, the plant efficiency must increase in a proportional manner at the low loads.

Figure 1 of Appendix 1, Section 17.1, shows a schematic view of the existing ID Fan arrangement, wherein, the dampers are rotated to control air flow.

Figure 2 of Appendix 1, Section 17.1, shows the proposed ID Fan arrangement. In this arrangement, because the damper already exists, it can be left in the full open condition, providing minimal losses, or it can be removed, providing no losses. In this arrangement, the fan is operated at the optimum speed to provide the flow required.

Because the plant efficiency is improved with the use of the VSFD, lower amounts of fuel will be consumed to produce the same kw-hours of electric power, and hence, correspondingly lower amounts of CO2 and other stack gases are produced. This will help to reduce "Greenhouse Gas Production".

The dampers are one of the high maintenance items in the ID Fan portion of the boiler. If the air flow is controlled by VSFD, and the damper function is eliminated, the ductwork will not be distorted by high differential air pressure, duct vibrations will be reduced, and damper maintenance will be eliminated.

The use of VSFD permits slow start up of ID Fans. If the fan rotors are bowed for any one of many reasons, they can be turned at slow speed to eliminate the bow, minimizing high amplitude vibratory forces in the bearings. This contributes to reduction of fan maintenance, and increases fan availability and reliability.

6. Project Description:

6.1. Purpose of this Section:

The purpose of this section is to address Project Background, Methodology, Project Content and How the Project will be Implemented, in detail.

6.2. Background:

In the late 1950s and 1960s, several large electrical generating plants were built with cycle designs that included variable speed fluid drives (VSFD) to drive the large fans and the major pumps, such as boiler feedwater pumps.

During the 1960s and 1970s when most of the large plants were built across the US, including the lignite-fired plants in North Dakota northwest of Bismarck, many of the plants were built with variable speed mechanical drive steam turbines for the boiler feed pumps. Most of the fans were usually constant speed, with flow controlled by louvers, dampers, or variable pitch blades. A major objective then was to build base load units because the country needed electrical power, and lots of it. Cycle design and equipment selection for a power plant were usually based only on overall efficiency (heat rate) at full load. Partial load calculations were made, but they were not usually considered in cycle or equipment selection. Air pollution was not as critical then, measurably because the environmental impact and the control technology were not well developed or understood. Global warming and greenhouse gases were not universal topics.

The world has changed. Today, air pollution, global warming, fuel efficiency regardless of the fuel, and operating/maintenance costs at all MW loads are important, and becoming more important with each passing day. Some power plants, perhaps most, will have to operate with variable MW load as the norm.

To address these issues, cycle design and equipment selection/ upgrades/ modifications are the methods for meeting the challenges. Introducing VSFD and improved steam path /gas path technology are two critical areas where significant improvements in overall plant efficiency can and will be made.

This project addresses VSFD, and leaves improvements in steam path technologies to others.

6.3. Methodology Used in the Design of Variable Speed Drives:

6.3.1. Alternative Designs of Variable Speed Drives.

The primary methods for providing variable speed power from 1000 hp to 40,000 hp (horsepower) are these:

1. Steam turbines.

2. Standard AC electrical motors and variable speed fluid drives.

3. Variable frequency solid state technology and AC motors. (Consists of solid state variable frequency drives, associated air conditioning for controls, matching special transformers, and matching motors.)

Factors to be considered in selection:

1. Capital cost.

2. Reliability.

3. Operating efficiency over the desired operating range.

4. Scheduled maintenance requirements and associated costs.

5. Space requirements.

6. Speed turn down ratio.

For the present application of ID Fans, steam turbines (Option #1) are not a strong consideration due to the location, which is outdoors. In addition long runs of steam and condensate piping, which could freeze in winter, would be required. The cost of piping and freeze protection added to the cost of turbines causes this option to be relatively expensive.

6.3.2. Relative Advantages

VSFD and standard induction motors (Option # 2) have advantages over the electronic variable frequency drives (Option #3), as follows: lower cost, measurably more reliable, lower maintenance requirements and costs, and greater turndown ratio (without cogging).

When comparing efficiencies, properly designed and sized VSFD offer average efficiencies of approximately 80% over the normal speed range, whereas electronic variable frequency drives offer an average of 83%, only 3 % difference. Fluid drives are less efficient than electronic variable frequency drives in the low speed end of the normal operating range, and are more efficient in the high speed end. In efficiency comparisons, for the electronic variable frequency drives, it is important to account for all of the power used for air conditioning and special transformers, as well as the high frequency losses in the motors.

TRI does offer a high efficiency version of the fluid drive, providing an average 86% efficiency across the speed range, with two speeds (any speed selected in the speed range along with the maximum speed) having 94% efficiency. The cost is approximately 30 to 50% higher than a standard design fluid drive.

Regarding space requirements, the fluid drive requires additional space in the mechanical drive train of the fan. However, the electronic variable frequency drive requires substantially larger space requirements within a short distance of the motor, and this space must be highly air conditioned. When the air conditioning or a solid state element device goes out, so does the fan.

6.3.3. Summary:

In summary, then, the VSFD design has been selected by TRI to be used in those applications requiring high reliability, low capital cost, and excellent speed turn down without cogging. It is important to keep in mind that while the efficiency differences between the electronic version and the fluid drive version may be debatable and may *depend upon the application, the overriding principle is that a VSFD provides a major efficiency improvement over the constant speed drives of the existing equipment.*

6.4. Background of Fluid Drive Methodology:

This projects is based upon the VSFD. It was invented in Germany in 1905, the technology moved to England and was further developed there in the 1930s, and on to the US under license to American Blower. The Industrial Products Division of American Standard was a successor company to American Blower, and some advancement in the technology was made by American Standard. Dr. Melbourne F. Giberson, now President of Turbo Research, Inc. and of its Division, TRI Transmission & Bearing Corp., has made several technical advancements in Fluid Drive Technology since 1973, as indicated by several US patents which have been awarded to him.

The novelty of the presently proposed Demonstration Project is to show that VSFD can be used successfully in retrofit projects to increase measurably the overall operating efficiency of lignite-fired power plants, particularly at lower MW loads, compared to present operation with constant speed drives.

While the overall efficiency improvements can be projected for various loads in the load range, it is very important for personnel within the North Dakota lignite industry to have their own first hand experiences with associated test data to confirm the improvements that can be achieved for fans of this size.

6.5. Anticipated Results:

At any MW load in the load range, for the same amount of lignite fuel used, greater electric power will be produced on a net basis.

These implications follow:

- lower CO2 and other stack emissions per kw-hr.

- lower operating costs at low load. This can be expected to decrease the overall cost of production and make lignite more competitive.

- lower maintenance costs for the fans.

- greater reliability for the fans, hence greater availability and reliability for the entire power generation unit.

6.6. Facilities, Resources, and Techniques to be used, and their Availabilities and Capabilities.

This demonstration project has well defined components and steps. The novelty is in the particular combination of equipment and the location.

The facilities involved are the ID Fans at the Leland Olds Unit 2. The concrete pedestals and foundations for the motors and drives need to be extended approximately 6 feet for each fan.

The Leland Olds plant resources and techniques required are these:

- conventional plant engineering work to design and supervise installation work;

- conventional reinforced concrete work;

- conventional mechanical installation work of rotating machinery and lube oil conditioning system;
- conventional electrical power cable removal and reinstallation;
- conventional instrumentation and control work; and
- conventional fan performance testing and report, before and after modifications.

The TRI resources and techniques required are these:

- conventional TRI fluid drive design work to adapt existing designs to suit the Leland Olds requirements;
- conventional TRI lube oil system design work to adapt existing oil system designs to suit the Leland Olds requirements;
- TRI management personnel with assistance from Basin Electric to identify companies within North Dakota which are qualified to provide the following components. (TRI normally purchases these items from Pennsylvania companies local to TRI):
    - Steel fabrication for the fluid drive housing, stress relief, and machining to TRI specifications;
    - Steel fabrication and machining for the base for the lube oil system;
    - Conventional rolling element bearings (SKF or equivalent);
    - Electro-mechanical actuators.

- TRI management to coordinate and inspect work performed in North Dakota, before it is shipped to TRI for final assembly.

TRI is of the opinion that such companies can be found in North Dakota, and that this will not significantly affect TRI costs or the final price. Note that these fabricated and purchased components can amount to 30 % or more of the final price of the TRI Variable Speed Fluid Drives and Lube Oil Systems.

- TRI will retain all critical work on rotating elements, gearing, balancing, and final assembly within TRI's shop.

The important point is that TRI is willing to work in a co-ordinated manner with the North Dakota lignite industry and North Dakota steel fabrication and manufacturing industry wherein TRI will provide products and services to improve the operating efficiency of the North Dakota lignite-fired power plants, and TRI will help to expand the manufacturing base of North Dakota. This will reduce the amount of money that leaves North Dakota in the process. If the working arrangement with the North Dakota steel fabricator and/or machining company(ies) is satisfactory, TRI would consider using these resources for fabrication/ manufacturing of other TRI fluid drives and lube oil systems for other clients.

6.7. The Environmental and Economic Impacts of the Project While it is Underway.

The foundation work could be performed while the unit is on line, and this would be performed by Basin Electric and North Dakota concrete contractors.

The lube oil system would be installed while the unit is on line.

During a scheduled outage, the motor would be moved (or replaced), the variable speed fluid drive would be installed, the train would be aligned, the electrical power cables reconnected, lube oil piping connected, instrumentation and controls connected, and the unit started up.

There is no apparent environmental impact from this work while the project is underway.

The economic impact would consist of additional employment and purchases in North Dakota for the work outlined above within the power plant and in the steel fabrication and machining facilities.

The economic impact for TRI is that this project would provide employment for several man-months.

6.8 The Ultimate Technological and Economic Impacts Resulting from this Project:

6.8.1. Ultimate Primary Technological Impacts:

The ultimate technological impacts when this project is implemented will be to demonstrate that properly sized and designed VSFD are very effective for:

- maximizing the operating efficiency, maintainability, and reliability of high power fans in power plants.
- helping to meet environmental regulations which favor reduced quantities of flue gases, including CO_2, per kw-hr.

- making it easier to optimize the flow and pressure of the flue gas through the boiler and any air pollution control equipment, relative to the use of dampers.

- reducing the minimum MW load at which the plant can operate stably.

6.8.2. Ultimate Primary Economic Impacts:

When this project is implemented, the Leland Olds Station will produce power at a lower cost, and will be able to swing loads easier. This improves the probability of long term utilization of the plant, which translates to improved probability of employment and utilization of the lignite fuels in North Dakota.

6.8.3. Secondary Impacts:

A second conclusion which follows is that properly sized and designed VSFD are very effective for maximizing the operating efficiency, maintainability, and reliability of all high power pumps and similar equipment, horizontal or vertical, in power plants.

It follows that subsequent economic impacts can be obtained by the implementation of additional VSFD throughout the Leland Olds Station and other power plants in North Dakota.

6.8.4. Tertiary Economic Impacts:

TRI has committed to manufacturing portions of the these and possibly other fluid drives in North Dakota, pursuant to statements in above paragraphs.

6.9. Why the Project is Needed.

This project is needed for the following reasons:

At the present time, most power plants in the US, including those in North Dakota, are spending no more money than is absolutely required to keep the plants running. This modus operandi is likely to continue until the future structure of the electric utility industry is settled, at least settled more than it is now.

The Leland Olds Unit 2 has had maintenance and operational problems with the dampers on both of the existing ID Fans. This project should result in greatly reduced damper problems to permit continued smooth operation of the unit.

If this Variable Speed Fluid Drive Demonstration Project is approved according to this Grant Application, the result is that it will then be possible for Leland Olds Station to obtain the benefits of

- permanently resolving the damper issue
- improving the technical design of the plant,
- improving the economic cost structure for the plant, and
- simultaneously demonstrating that this technology will help all of the lignite industry in the continued efforts to improve environmental matters, improve control of the combustion process, reduce costs, improve maintainability, availability, and reliability.

7.1. Primary Standard of Success:

The primary standards of success for this project will be the comparison of the electric power consumed by the motors which drive the ID fans before and after the implementation of the VSFD, measured at the same net MW generation points, from minimum stable generation point to maximum generation. Likewise, the amounts of combustion gases (sulfur dioxide, nitrogen oxides and carbon dioxide) will be measured using the station's existing continuous stack emissions monitors.

Another way to measure the success is to compare net heat rates before and after modification at various net MW loads. However, heat rate measurements are believed to be far less accurate than the aforementioned success measurements.

7.2. Secondary Standard of Success:

Comparison of the ID Fan ductwork vibration amplitudes before and after at same MW generation loads.

Comparison of the ease of controlling the flue gas through the boiler, and ease of controlling the air pressure within the boiler.

8.1. Background of Fluid Drive Methodology:

The Variable Speed Fluid Drive was invented in Germany in 1905. By the 1930s, it was further developed in England. This technology was licensed to American Blower in the 1930s, and was used to provide variable speed power for fans and pumps at that time. The Industrial Products Division of American Standard was a successor company to American Blower, and some advancement in the technology was made by American Standard through the 1960s.

Dr. Melbourne F. Giberson, now President of Turbo Research, Inc. and of its Division, TRI Transmission & Bearing Corp., has made several technical advancements in Fluid Drive Technology since 1973, as indicated by several US patents which have been awarded to him.

TRI has been manufacturing complete fluid drives since 1985, primarily for boiler feed pumps for large power plants. The total power for all of the fluid drives which TRI has manufactured/remanufactured exceeds 400,000 hp.

TRI remanufactured an 8,000 hp Voith Variable Speed Geared Fluid Drive for an Auxiliary Boiler Feed Pump for the Limestone Generating Station, Houston Lighting and Power Company in the early 1990s. The Limestone plant is lignite-fired, and is located in Jewett, Texas. J. Paul Martin was the purchasing agent.

Two different brochures are attached which describe TRI fluid drives for fans, pumps and compressors.

A photograph of a recently manufactured fluid drive is also attached. Four such fluid drives were manufactured by TRI for Demag-Delaval Turbomachinery Corp. They are being installed on a natural gas handling platform being built for Pemex.

The novelty of the presently proposed Demonstration Project is to show that VSFD can be used successfully in retrofit projects to increase measurably the overall operating efficiency of lignite fired power plants, particularly at lower MW loads. There is no significant novelty for this project in the technology within the VSFD.

8.2. Other Organizations which Manufacture Variable Speed Fluid Drives:

The companies which manufacture high powered variable speed fluid drives without internal gears are TRI, Voith, Hitachi, and Howden. VSFD with internal gears are manufactured by TRI, Voith, and Hitachi.

Voith is German, with products made in Germany and in India. Hitachi is a Japanese company. Howden is a Scottish company and its parent company is Charter, a British Holding Company. TRI is a 100% American owned company.

9.1. Qualifications of the Applicant:

The Leland Olds Station is one of the earliest lignite-fired power plants in North Dakota.The plant management consists of individuals with engineering backgrounds and experience suitable for managing the modifications involved in this project. Where specialty personnel are appropriate for foundation design and construction, Basin Electric and/or local contractors are available.

9.2. Qualifications of the Sub-Applicant:

Turbo Research, Inc. and its Division, TRI Transmission & Bearing Corp have been involved in the work of upgrading power plants since 1971, and have been involved in the design, manufacture, and supply of new fluid drives since 1985.

Resumes for four of TRI's engineers that would be associated with this project are attached.

A list of US Patents for improvements in Fluid Drive Technology awarded to Dr. Giberson is provided below:

Patent Number:	Subject
5,331,811	Fluid Drive Impeller Design and Manufacture
5,315,825	Oil Systems for Fluid Drives
5,303,801	Brake System for Fluid Drives
5,505,662	Quick Disconnect Coupling for Fluid Drives

A copy of TRI's Quality Assurance Manual is available upon request.

10.1. Utilization of the Results of the Project:

The lignite-fired power plants are expected to be the primary ones who will utilize the technology demonstrated in this project. However, VSFD can be used effectively for almost all pumping, fan, and compressor applications between 400 hp to 40,000 hp.

Municipalities with vertical pumps in this power range can also utilize the technology. Major benefits will be lower cost and/or more efficient use of electricity and fuels.

10.2. Enhancement of the Use of North Dakota's Lignite:

The use of suitably designed and sized VSFD will reduce the cost of power produced by the large lignite-fired power plants and reduce stack emissions. When used on all of the major fans and pumps, the reduction of operating costs may be on the order of 1 % to 3 % for the entire Unit 2, which is significant. A purpose of this project is to provide clearer identification of the anticipated cost savings when fully implemented. Such a reduction of cost can help the North Dakota lignite-fired plants to compete with electric power from other fuels and/or in other states on the basis of cost and environmental concerns.

10.3. Preservation of Existing Jobs and Creation of New Ones:

Projects such as this one involving the implementation of VSFD that result in improved environmental compatibility, improved combustion of fuel within boilers, improved plant availability, and improved reliability inevitably lead to improved prospects for continued operation of the modified and upgraded plants, and possibly new plants using the same improved technology. There is an immediate connection to preservation of existing jobs and the possible creation of new ones.

Also, as indicated above, TRI has committed to manufacturing portions of the fluid drives which are part of this project in North Dakota, and possibly other fluid drives in the future, as outlined above. This is a direct creation of new jobs in North Dakota for a new market.

10.4. Priorities Established in North Dakota Century Code Section 54-17.5-03:

This Demonstration Project of implementing VSFD for ID Fans has several features consistent with the objectives of Section 54-17.5-03 of the North Dakota Century Code:

- It can be implemented within approximately 8 months after project approval. In other words, if project approval is received by March 1, 1999, the equipment and foundation work could be ready for installation by October 1, 1999. During a short outage in late 1999 or in the maintenance outage of April 2000, the project would be implemented. Test results would be available and a report issued within two months after completing the installation. All of this should be completed no later then July 2000. There is very little risk associated with the implementation of this project, or the date by which implementation can be achieved.

- There are matching funds available from the Applicant at this time.

- It will contribute to the preservation of existing jobs both in the lignite industry and in the steel fabrication and manufacturing industry in North Dakota.

- It will provide baseline information regarding how much improvement in operating efficiency can be obtained at various fan flow/pressure conditions.

- With the value of this project thus determined using firsthand data available from a plant within the North Dakota lignite industry, it is more likely that additional VSFD will be installed and similar benefits derived therefrom for other North Dakota lignite-fired plants. This may well occur without additional state funding.

11.1. Management and Responsibilities for the Various Parts of the Project:

The primary management of the project will be provided by Mr. Fred Stern, Plant Manager, Leland Olds Station or his designate.

The project consists of four major parts:

Part 1. Design, Manufacture, and Supply of the Variable Speed Fluid Drives and Oil Systems. Management of this part will be provided by Dr. Melbourne F. Giberson, TRI President. Responsibility for performing sub-parts of this Part will be assigned to TRI staff engineers. Design and progress will be monitored by Dr. Giberson

Part 2. Foundation Modification Design and Installation. Management responsibility for this part will be assigned to Basin Electric staff engineers.

Part 3. Installation of the new Rotating Equipment and Oil System. Management responsibility for this Part will be assigned to Leland Olds Station staff engineers. TRI engineering and technical personnel will be responsible for providing Technical Direction of the installation of the new equipment and oil system, including controls. Leland Olds Station personnel or their contractor will be responsible for actual installation work.

Part 4. Start-up, Testing, and Report Preparation. Management responsibility for this Part will be assigned to Leland Olds Station engineering personnel, with assistance from Basin Electric corporate staff engineers. TRI personnel will participate in all aspects of this Part.

11.2. How the Project will be Overseen to Ensure that it is Being Carried out on Schedule.

Important points regarding the execution of this project are the following:

For TRI, designing, manufacturing, and installing variable speed fluid drives is a core business. There are no new concepts or processes involved. TRI builds fluid drives and oil systems in six months after receipt of order as a normal course of business.

For Basin Electric, modifying foundations and other parts of the Leland Olds Station is a normal course of business. This project has no apparently novel features. Installation of equipment, testing, and report writing are also normal business activities.

It is normal to have periodic reviews of projects at both TRI and Leland Olds, and this project and its Parts would be no exception.

11.3. Description of Evaluation Points During the Course of the Project.

11.3.1. Scheduling and Monitoring Projects:

TRI uses Micro-soft Project for scheduling projects such as this one. TRI also has additional specialized computer-based design and manufacturing processes for fluid drives which utilizes a list of items which must be accomplished. The TRI Quality Control Manual addresses many of these items: drawing preparation and approval, materials and vendors specifications, materials documentation, manufacturing steps and associated travelers(written step-by-step record) for each component, assembly drawings, records, related data and written data for any tests made, including balance data. These computer based programs are updated regularly. TRI management can determine the status of the project by reviewing these project control programs.

The Leland Olds Station also has computer based programs for scheduling and monitoring the status of various projects, and these programs will be used for this project and its various Parts.

11.3.2. Evaluation Points Specific to this Project:

Upon notification of project approval, TRI and plant personnel would meet to confirm the project plan and associated "Milestone" dates. TRI would then forward project accomplishments corresponding to specific "Evaluation Points" to the Leland Olds Station in accordance with the Schedule of Section 12. Likewise, the Leland Olds Station would forward site accomplishments corresponding to specific "Evaluation Points" of their portion of the project to TRI.

12.1. "Milestones" Dates for the Four Parts of the Project:

Milestone dates for the project shown in "Months after Receipt of Approval to Proceed" are as follows:

	Month
Initiation Meeting:	1

<u>Part 1. Design, Manufacture, and Supply of the Variable Speed Fluid Drives and Oil Systems.</u>

	Month
Fluid Drive	
Overall Design Complete	1
Details Complete and all materials on order:	2
Housing	
Fabrication and Machining (North Dakota)	3,4
Inspection and Shipment to TRI	5
Rotating Elements	
Receipt of Materials	2,3,4
Machining of Components	2,3,4,5
Assembly and Balance	5
Final Assembly	6
Shipment to Site	7

Oil System	
Overall Design Complete	1
Details Complete and All Materials on Order	2
Fabrication of Bases	3,4
Inspection and Shipment to TRI	5
Final Assembly	6
Shipment to Site	7
<u>Part 2. Foundation Modification Design and Installation.</u>	
Foundation Modification Design	1,2
Select Concrete Foundation Installation Contractor	3
Install Foundation Modifications	4
Install Concrete Pad for Oil System	4
<u>Part 3. Installation of the new Rotating Equipment and Oil System.</u>	
(timing dependent on outage dates)	
Receive Variable Speed Drives from TRI	7
Receive Oil Systems from TRI	7
Prepare Variable Speed Drives for Installation	7
Install Oil System, except for Final Pipe Connections	7
Delay, if any, until Outage Starts (Delay not counted in schedule)	7

Remove Existing Motor	7
Remove Existing Soleplates, Install New Soleplates and Grout	7
Install New Equipment, and Align	7

Part 4. Start-up, Testing, and Report Preparation. (timing dependent on outage dates)

Start-up and Test	8
Prepare Report	9
Project Completion	9

12.2. Reports to the North Dakota Industrial Commission, per Section 43-03-05-08:

Interim Reports will be submitted to the Commission notifying the Commission that the following "Milestones" have been accomplished, unless the Contract specifies otherwise:

Fluid drive housings are complete.

Fluid drive assemblies and oil systems are complete and shipped.

Foundation modifications are complete (except for final grout work).

Equipment has been installed, and started.

Final report will be submitted to the Commission when the testing is complete and project objectives have been measured according the Standards of Success of Section 7, unless the Contract specifies otherwise.

TRI Variable Speed Fluid Drives for Induced Draft Fans at the Leland Olds Station, Basin Electric Power Cooperative.

13.1 Budget Breakdown by Items.

The items in the budget and the associated costs are as follows:

	TRI	Leland Olds
Initiation Meeting	$ 3,000.	$4,000.
Part 1. Variable Speed Fluid Drives Prices Shown are for 2 Fluid Drives and associated oil systems, together		
Option 1 No Gears, Existing Motor	216,000.	
Option 2. Internal Gears and 2 new 1175 rpm Motors	262,000.	
Option 3. High Efficiency Design, Existing Motor	296,000.	
Part 2. Foundation Modifications (Qty = 2, priced together)		
Engineering Design Work		15,000.
Concrete Contractor		30,000.
Part 3. Equipment Removal and Installation (for both):		
Disassembly and Removal		8,000.
Oil System Piping, Wiring, and Instrumentation	10,000.	
Sole plate Installation and Final Grouting		15,000.
Flexible Coupling and Miscellaneous Purchase		35,000.
Drive, Coupling and Motor Installation/ Alignment	10,000.	20,000.
Part 4. Start-up, Testing and Report Preparation	6,000.	12,000.
Totals, Assuming Variable Speed Option 1:	$235,000.	$149,000.

13.2. Project Total Budget:

Project total is budgeted at $ 384,000.

13.3. Budget Allocation by Salaries, Outside Purchases, and Fixed Price Charges

The costs under "Leland Olds" represent salaries of plant or corporate staff personnel during the time that they would be assigned to this project at $84,000. Outside purchases amount to $35,000 and the cost of a contractor for concrete work is estimated at $30,000.

The costs under TRI for the initiation meeting and site work for installation cover salaries and overhead for TRI employees while on site, and are shown in TRI's Standard Rates and Policies, copy included in Section 17. In this case, these charges would be invoiced to Leland Olds as Fixed Price Charges. The costs under TRI for the Fluid Drive Options represent fixed price charges for the hardware purchased. These cover TRI salaries, materials, and overhead. There is no anticipation of contingency or profit in these prices for TRI.

13.4. TRI to Return of a Portion of this Project Budget to North Dakota:

Approximately 30% of the Fluid Drive Costs, or approximately $65,000 of these charges would be returned to North Dakota for steel fabrication and machining work on the housings, as committed to by TRI in the Transmittal letter and in other Sections.

Other purchases for standard items which TRI normally purchases from outside sources will be made from North Dakota vendors, as well. These standard items are comprised of rolling element bearings, actuators, and the like.

13.5. Amount of Grant Requested

A Grant in the amount of $ 180,000 is requested. This is 46.9 % of the budgeted amount for the entire project.

13.6. Justification for the Amount Requested:

There is no money currently budgeted by Basin Electric for VSFD upgrades at the Leland Olds Station. Plant management believes that VSFD would improve the efficiency of the plant, however, without appropriate test data to demonstrate the economics of VSFD, upgrades are difficult to justify. The Induced Draft Fan application is unique because it would allow for results to be obtained in a high horsepower case and minimize damper problems.

As can be seen in the Summaries provided in Section 14, with a Grant in the amount of $180,000., the project budget is balanced as follows:

Summary of Project Budget Sources:

Grant Amount Requested	$ 180,000.
Basin Electric Commitment (if Grant is approved)	204,000
Total Budget Sources	$ 384,000.

Summary of Project Budget Expenditures:

TRI Variable Speed Fluid Drives	$ 216,000.

TRI Initiation Meeting and Site Work	19,000.
Plant and Corporate Salaries	84,000.
Flexible Coupling and Miscellaneous Purchases	35,000.
Concrete Contractor	30,000.
Total Expenditures	$ 384,000.

13. 7 Implications of Partial Grant Funding, or of Increased Grant Funding:

As indicated above, there is no funding available to Leland Olds for VSFD upgrades from the Basin Electric corporate sources. Consequently, if a Grant in the amount of approximately $180,000 is not approved, the project can not proceed at this time.

It should be stated that if additional funding is available, Variable Speed Options 2 and/or 3 would be pursued, as they do represent significant improvements in operating efficiency of the ID fans for relatively modest increases in project cost.

14.1. Summary of Available Funding Sources:

As explained in Section 6, there is no money budgeted by Basin Electric for VSFD upgrades at Leland Olds, even if they will improve the efficiency of the plant. However, the Induced Draft Fan situation is unique because it would allow cost savings to be determined in a high horsepower case.

With a Grant in the amount of $180,000., the project budget is balanced.

Summary of Project Budget Sources:

Grant Amount Requested:	$ 180,000.
Basin Electric Commitment (if Grant is approved)	204,000.
Total Budget Sources	$ 384,000.

14.2. Summary of Planned Expenditures

The details of the budget are given in Section 13, shown here in summary form::

Summary of Project Budget Expenditures:

TRI Variable Speed Fluid Drives	$ 216,000.
TRI Initiation Meeting and Site Work	19,000.
Plant and Corporate Salaries	84,000.
Flexible Coupling and Miscellaneous Purchases	35,000.
Concrete Contractor	30,000.
Total Expenditures	$ 384,000.

TRI is of the opinion that, in a significant manner, it is contributing to the Matching Funds in two ways: by pricing its fluid drives and oil systems at its anticipated cost level, and by returning approximately 30% of the TRI price to North Dakota vendors for fabrication and machining work, as well as for purchasing standard products manufactured by others.

15.1. Status of Tax Liability for Basin Electric Power Cooperative:

Basin Electric Power Cooperative has no outstanding tax liabilities to the State of North Dakota or to any of its political subdivisions.

15.2. Status of Tax Liability for Turbo Research, Inc.

Turbo Research, Inc., and its Division, TRI Transmission & Bearing Corp. have no outstanding Tax Liability to the State of North Dakota or to any of its political subdivisions.

There is no confidential information in the Application.