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34.0 OPERATING AND MAINTENANCE PLAN

34.1 INTRODUCTION

The operating and maintenance plan outline describing resources and facilities necessary to ensure safe and efficient operation of the pipeline system is presented in the following sections. The general plan presented here will be developed into a detailed program prior to mechanical completion with facilities, equipment, personnel, training programs, written procedures, and an organization to integrate these resources into a functioning system. The system design and procedures will be developed in compliance with DOT 49 CFR, Part 191 and 192. A detailed organization structure for the operations phase of the project will be developed as well.

34.2 CODES AND CRITERIA

34.2.1 Codes

- Code of Federal Regulations, Title 18 – Conservation of Power and Water Resources
- Code of Federal Regulations, Title 49, Transportation, Part 191, Transportation of Natural and Other Gas by Pipeline; Annual Reports, Incident Reports, and Safety-Related Condition Reports
- Code of Federal Regulations, Title 49, Transportation, Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
- National Association of Corrosion Engineers, Recommended Practice, "Control of External Corrosion on Underground and Submerged Metallic Piping Systems," NACE RP0169-96.
- Federal Right-of-Way Grant for the Alaska Natural Gas Transportation System Alaska Segment, Serial No. F-24538 (December 1, 1980), as such may be updated and/or amended from time to time
- Federal Energy Regulatory Commission conditional certificate of public convenience and necessity, issued on December 16, 1977, as such is finalized

34.3 OPERATIONS AND MAINTENANCE

34.3.1 Operating Philosophy

The Alaska Segment will be controlled and operated from a central Operations Control Center (OCC) located in Calgary, Alberta, Canada which will control both the Alaskan and Canadian Segments of the ANGTS pipeline from Prudhoe Bay to Alberta. Gas Control at this control center will implement the detailed system operating plan by interfacing with the upstream conditioning plant at Prudhoe Bay and the downstream Canadian and Lower 48

pipelines. Delivery volumes will be established by matching nominated gas volumes with contracted volumes, gas volumes available from the conditioning plant, and take-away capacities of the downstream pipelines. The ANGTS pipeline OCC will be linked through the communications system to the control center of the gas conditioning plant at Prudhoe Bay and the control center(s) of the downstream Canadian pipelines. Contact with control centers at each of these locations will be made periodically in order to establish operating parameters at the interface level of facilities. In the event of a sudden, unexpected change, each control center will be informed so that operating procedures can be adjusted.

Although the Alaska segment of the ANGTS pipeline will have certain limited capacity to permit temporary imbalance between gas receipt at Prudhoe Bay and gas delivery at the Yukon border, the OCC must balance these conditions within acceptable limits. To facilitate this, a hydraulic real-time computer simulation program (“Real Time Model”) will be used to track the real time state of the operating conditions along the pipeline to predict operating pipeline dynamics for the following day’s operation. The gas dispatcher at the OCC will use this simulation program to determine set points for each compressor station on the pipeline on at least a daily basis, or more frequently as circumstances may require. Once the set points have thus been established, each individual station control system will take command of the station and will operate all station systems according to preprogrammed relationships. Initially, system technicians and equipment specialists will be available at each station on a relatively continuous basis. Thereafter, upon the system having demonstrated the anticipated level of system reliability on a consistent basis, an automated, unmanned operation mode will be implemented wherein maintenance personnel would only visit each station periodically.

The OCC will operate the ANGTS pipeline in a manner such that the nominated volumes are transported efficiently and reliably. Pipeline pressure set points at each compressor station will be established based upon the predictive analysis of the Real Time Model so as to maximize total system efficiency, thereby minimizing the resultant total fuel consumption. The refrigeration systems at each station will be operated as necessary depending upon ambient temperature variations to control station gas discharge temperatures for the purpose of preventing permafrost degradation and inordinate frost heave build-up.

The pipeline block valves, located approximately every 20 miles, will have at least local manual control, and perhaps automated control should an automated rupture detection system using the Real Time Model be implemented. Should it be necessary to service the pipeline, the block valves would be used to isolate the specific section of pipeline to be serviced, and thereby minimize the volume of gas needing to be recovered or vented into the atmosphere. All mainline valve assemblies will be equipped with appropriate connections and valves so that pull-down compressors can be attached to recover the gas in the section to be blown down.

The metering facilities for the Alaskan segment will be monitored from the OCC. ANNGTC personnel will test and calibrate equipment such as gas chromatographs, flow meters, dew point recorders, water and hydrogen sulfide analyzers, and pressure relief devices. Total gas flow values will be calculated locally and will be telemetered to the central OCC as well as to Head Office, Alaska for accounting purposes.

ANNGTC personnel will operate and maintain the communications systems in Alaska. Communications facilities will be located at each of the compressor and metering stations, at

the Fairbanks Maintenance Facility and regional control center, and at the central OCC facilities in Calgary. To ensure maximum reliability, each major component of the communications and supervisory control system will have built-in redundancy, including the main computer at the central OCC, the communications links, and the station control systems. In the event of communications link failure with the central OCC, the Alaskan segment control would be assumed by the secondary regional control center at the Fairbanks Maintenance Facility; in the event of total communications systems failure, personnel from the Fairbanks Maintenance Facility would be dispatched to the respective compressor stations to locally monitor and operate the station control systems.

34.3.2 Head Office and Central Maintenance Facility

Head Office and operations support personnel will be located in a head office facility located in either Anchorage or Fairbanks. An Alaskan Central Maintenance facility will be located in Fairbanks, Alaska, and will be the center for the operating/maintenance personnel and equipment for the Alaskan segment. The Fairbanks Maintenance Center will also house the regional control center for the Alaskan portion of the ANGTS pipeline. Secondary maintenance facilities may also be located in Deadhorse and in Delta Junction.

The primary function of the Central Maintenance Facility in Fairbanks will be to provide an efficient working environment for personnel and equipment.

The facility will house the following operations and maintenance equipment:

- Supervisory control computer
- Non-interruptible power supply and generator equipment
- Communications equipment
- Heating and ventilating equipment
- Office equipment

34.3.3 Maintenance Facilities

Maintenance of the system will be performed out of district Maintenance Facilities under the direction of the OCC.

District Headquarters will accommodate company vehicle storage and service requirements and be available to contractors for vehicle storage when required.

Maintenance equipment will be permanently stationed at each Compressor Station including the equipment necessary for handling large items such as valves, pipe, drums, pumps and other miscellaneous items.

Where required, helicopter pads will be built outside compressor station fences. Although helicopter will be the primary means of air transportation to remote sites, provision may be made for fixed-wing air travel to remote compressor station sites where existing nearby airfields are available.

Each compressor station will have a full complement of tools for repairing or replacing installed equipment.

- Spare parts and operating supplies will be stocked at each compressor station location and the Fairbanks Maintenance Center.
- The Fairbanks Maintenance Center will be the principal receiving and distribution center. Major spare parts and assembled replacement components will be stored at both the northernmost station and at the warehouse.

Operating supplies such as filter cartridges, lube oils, and chemicals will be stored at each compressor station. Procedures for handling, storing, and disposing of the latter, lube oils and chemicals, will be prescribed by criteria, manuals, and plans. These include: Criteria for Fuel Storage and Distribution Systems; the Petroleum Handling Procedures Manual; the Pesticides, Herbicides, and Chemicals Plan; the Hazardous Wastes Disposal Plan; and the Hazardous Substances Plans.

34.3.4 System Maintenance

The following programs will be implemented to provide the high level of reliability required by the operations.

34.3.4.1 Compressor Station Maintenance

Periodic inspections and tests will be performed on compressor station instruments and equipment to verify their proper and safe operation. These operational instruments and equipment include gas and fire detection, pressure control, pressure relief and emergency isolation and shutdown.

Inspections, tests and calibrations of instruments and equipment will be performed by crews dispatched from the district maintenance facility. These crews will also perform preventive maintenance on equipment and maintain appropriate records. Regular overhauls of rotating equipment will be undertaken at intervals as recommended by the manufacturers.

34.3.4.2 Pipeline Maintenance

Regular maintenance and inspections will be performed on the pipeline system to verify proper and safe operation. Specialized equipment is used to carry out diagnostic checks and necessary repairs.

The pipeline surveillance program covers aerial and ground patrol, leak detection, mainline valve inspections, monitoring for unauthorized construction activity, frost heave and/or soil disturbances on the pipeline right of way.

Pipeline repair equipment will be available from contractors retained for major repairs and maintenance. This equipment will be located at strategic locations north of Atigun Pass and near Fairbanks to minimize travel time from the base to the repair site. A maintenance crew will be dispatched from the district maintenance facility to the repair site. Mobile radios or the equivalent will be installed in each company vehicle to aid in activity coordination and to ensure communication in the event of an emergency.

34.3.4.3 Cathodic Protection

The pipeline system will be buried for most of the length of the right-of-way, except for certain river crossings. Therefore, a cathodic protection system will be installed to ensure the integrity of the pipeline system. The cathodic protection anodes will be installed along the pipeline route and at compressor and metering stations. It will require certain maintenance functions to ensure proper performance, including complete electrical survey of the line to determine that the pipeline has satisfactory cathodic protection potentials. Sample potential surveys will be conducted to locate possible problem areas and establish yearly patterns.

- Inspection of each rectifier at intervals to ascertain that they are functioning properly.
- Preparation of reports documenting cathodic protection system surveillance and overall performance.
- Cathodic protection system will be maintained in compliance with DOT 49 CFR, Part 192 and NACE RP0169 standards.

34.3.4.4 Pigging

Pig launching and receiving facilities will be located at intervals along the length of the pipeline, generally at compressor or meter stations.

Considerable development work has been done since the inception of ANNGTC project in the area of pipeline monitoring using sophisticated pigging devices. ANNGTC intends to use the latest available technology in its pigging operation. ANNGTC intends to use high-resolution magnetic flux leakage (MFL) in-line inspection tools (pigs) to monitor corrosion, and geometry/inertial mapping in-line inspection tools to monitor pipe movement and distortion. Cleaning tools will also be used in advance of in-line inspection runs, as required. ANNGTC personnel will supervise launching and receiving all pigs.

34.4 SYSTEM SECURITY

The security of the pipeline facilities is of paramount importance to the overall operations. The OCC will be manned on a continuous basis. Security personnel will be assigned to the building. Entrance to the control room will be limited to authorized personnel.

Compressor and metering stations will be fenced to keep out predators and unauthorized personnel. Stations will have intrusion alarm tied into the station control system that is telemetered to the OCC. This alarm system will alert the OCC dispatcher, who will notify the nearest district maintenance personnel who will, in turn, investigate the incident. Pipeline security will be enhanced because the pipeline is buried almost everywhere. Fencing will be used to limit access to valve top works along the system. Aerial spans will be equipped with barricades and fences to limit access.

Aerial patrolling of the system will be performed on a scheduled basis. Pipeline milepost markers identifiable from the air will allow pinpointing the location where activities are taking place in the vicinity of the pipeline. Valve position markers will also be provided so aerial surveillance can be performed.

34.5 SAFETY PROCEDURES

Safety is also of paramount concern to the overall operations. Procedures will be established and implemented for the safe operating and maintenance of the pipeline and facilities in accordance with 49 CFR, Part 192, which details the minimum federal safety standards for operating and maintaining pipelines. Reporting requirements for operating and maintenance incidents and safety related conditions will be in accordance with 49 CFR, Part 191. Other procedures that address general and unique health and safety issues at the facilities and along the pipeline right-of-way shall be developed. This safety program will be controlled through employee indoctrination and training, safety inspections, reporting requirements, and safety meetings. Managers at the facilities will be responsible for implementation and dissemination of the safety procedures to employees working in areas of their responsibility.

34.6 FIRE PROTECTION

Each compressor station will operate under its own master control system and back-up emergency shutdown system. If equipment malfunctions, the system will shut down the facility in a safe manner. In the event that high gas concentrations are detected in any of the buildings housing rotating equipment, additional ventilating fans will be turned on to increase air turnover alleviating this condition. If an explosive limit is reached or if a fire is detected, the emergency shutdown system will be automatically activated at the station, closing the station side valves, opening the station block valve and venting the gas in the station piping to the flare. Gas will continue to flow through the open station block valve.

34.7 SEISMIC MONITORING

Seismic monitoring will be maintained at each compressor and metering station. This system will tie into the station alarm system notifying the OCC dispatcher of a seismic occurrence. The OCC dispatcher will determine and initiate appropriate action based on the seismic condition.

34.8 MAINTENANCE PERSONNEL

The maintenance team will consist of multi-skilled personnel able to handle the normal day-to-day operations, minor repairs, routine maintenance, and contingency operations. Pipeline repair and maintenance and right-of-way maintenance will probably be performed by contractor personnel.

Although Alaskan Northwest Natural Gas Transportation Company (ANNGTC) personnel will operate and monitor the cathodic protection system and inspect the mainline valves, contractors will probably be retained to perform any right-of-way work, work pad maintenance, line repair, aerial patrol, leak surveys, and communication equipment maintenance. Each contractor will furnish its own equipment. Joint maintenance of the work pad with Alyeska will be investigated.

All outside contractors will adhere to a written operating and maintenance plan and all welding will be accomplished in accordance with current welding procedures and qualifications for the job being performed.

Support services such as catering, fuel, and rotational personnel transportation will be subcontracted to local businesses specializing in these types of support services.

34.9 EQUIPMENT

The equipment required for operations and maintenance was developed by considering the necessity for safe and efficient operation of a large diameter pipeline in the Alaskan environment.

34.9.1 Transportation Equipment

Maintenance personnel will maintain all vehicles in their district. Gasoline and diesel fuel will be available at each compressor station location. Facilities will accommodate company vehicles' requirements and be available to contractors for vehicle storage when required. Central storage will be provided and will include standby fuel for emergency generators and auxiliary building heating.

Helicopter will be the primary means of air transportation to remote sites. However, provision may be made for fixed-wing air travel to remote compressor station sites, where there are existing nearby airfields.

34.9.2 Maintenance Equipment

Besides transportation vehicles, maintenance equipment (i.e., the equipment necessary for handling large items such as valves, pipe, drums, pumps, and other miscellaneous items) will be permanently stationed at each compressor station.

Other needs include snow removal and handling fill materials for station site maintenance.

In addition to equipment required for compressor station maintenance, pipeline maintenance equipment will be required. Although most of the large maintenance equipment items will be contracted, certain equipment will be owned and maintained at the district maintenance facilities.

34.9.3 Shop Equipment

Each district maintenance facility will include a maintenance shop, which will be used primarily for servicing transportation equipment.

Test facilities will be provided at each compressor and metering station for checking instruments, gauges, relief valves, and electronic components comprising the control system. Each compressor station will have a full complement of tools for replacing the different components of the installed equipment. Crews within each district will be trained to operate

the shop equipment so that facilities can get maximum use with a minimum number of employees.

34.10 SPARE PARTS PLAN

Operating supplies and mainline pipe will be stocked at each operating location and the Fairbanks Maintenance Center.

Spare parts are based on industry standards and will be adjusted for the Alaskan operations. Operation of the segment will continue with a compressor station out of service; however, gas flow will normally be maintained at a reduced rate

Control systems will be designed so key components are spared allowing for maintenance without interruption of service. Replacement will be performed quickly because most items requiring replacement are plug-in or quick-change type components.

Spare operating parts, such as filter cartridges, lube oils, chemicals, etc., will be stored at each compressor station.

All major spare parts will be purchased at the same time as the equipment to achieve economies and to facilitate fabrication, fitting, and testing with the original equipment.

Lease and exchange plans available from gas turbine engine manufacturers will be evaluated to augment overhaul and emergency needs.

34.11 COMMISSIONING AND STARTUP

The following is a list of some of the commissioning and startup procedures that will begin after mechanical completion.

34.11.1 Commissioning

As a final phase of construction, startup and commissioning will be implemented. A cadre of operations personnel previously hired and trained for their specific assignments will be on hand to monitor and oversee the mechanical completion and startup of the equipment. All personnel will become familiarized with the basic characteristics and safety considerations of working on natural gas facilities.

34.12 OPERATING AND MAINTENANCE MANUAL

An Operating and Maintenance Manual will be prepared by the time construction is completed. The manual will include procedures for inspecting, testing, and maintaining the pipeline facilities as set forth in manufacturers' manuals and the DOT 49 CFR, Part 192. Procedures in this category include items such as patrol of the pipeline, corrosion control testing, emergency valve inspection and maintenance, repair procedures, and development of emergency plans. Procedures for guiding and instructing employees during routine operations and repairs of all system facilities will also be developed.

34.12.1.1 Inspection and Maintenance Plan

An Inspection and Maintenance Plan will be developed after the outline for the Operating and Maintenance Manual has been approved. The directions for performing inspections, tests, and maintenance, as required in the 49 CFR 192 regulations will be included within the plan. This will include inspection and testing of relief devices, inspection and maintenance of emergency valves, pipeline monitoring, patrol frequency and methods, population density surveillance plans, and corrosion control surveillance.

34.12.1.2 Emergency Plans

Emergency plans for handling abnormal operating conditions will be prepared prior to the startup date of the pipeline system. It is necessary that personnel be familiar with various types of emergencies to allow time for company supervisors to make follow-up contacts with police and fire departments and other public officials. Contact with these officials and departments before start-up will result in ANNGTC being aware of the resources available to aid appropriate response to an emergency.

The types of emergencies for which ANNGTC notifies these officials and plans of mutual assistance for minimizing hazards to life and property during an emergency will be specified.

34.12.1.3 Maintenance Instructions

Specific how-to instructions will be developed for all equipment installed in the system requiring periodic inspections, tests, calibration, or adjustment. These instructions will be developed in conjunction with the manufacturers published recommendations and literature, and will contain adequate detail allowing performance of tasks by individuals after limited training. The required frequency of task performance will be identified within the detailed Operating and Maintenance Plan. Frequencies of task performance will be modified as dictated by operating conditions or identified problems.

34.12.1.4 Records

A system of permanent record of maintenance will be prepared to comply with DOT regulations and to accumulate other pertinent operating records or data that may be useful or important in determining maintenance frequency, repair needs, and trends in equipment performance. The planned system will maximize the use of computer and other data processing technology that will collect and retain data and have future recall for utilization in the ongoing system operation. It will also minimize record storage requirements and personnel required for maintenance retrieval. This records system will be developed concurrently with the Operating and Maintenance Plan and will be functional at the time the pipeline system is placed into operation.

34.12.1.5 Confirmation of Installed Facility

During construction, engineers and inspectors will be monitoring construction activities to ensure that the proper materials are installed, the required nondestructive testing is done, and the facility is installed in accordance with its drawings and specifications. At the conclusion of construction, all accumulated records will be consolidated and reviewed in order to make a final confirmation that the facility is ready for initial operation.

34.12.1.6 Training

Prior to the commissioning and startup of the pipeline, the maintenance personnel will be instructed in system operation and maintenance, basic characteristics of natural gas, and required safety practices that must be observed while working on facilities handling or containing natural gas. They will become familiar with procedural requirements, maintenance manuals, or specific instructions and maintenance of specific components and the emergency plan, including predetermined employee response or responsibility during an emergency. The training will also include detailed instructions on the plan developed for purging and loading the line.

34.12.1.7 Pre-Startup Maintenance

Prior to purging and pressurizing the pipeline system, all operating components will be checked in accordance with developed maintenance procedures and instructions. This will include, but not be limited to: lubrication and operation of all valves; and lubricating, testing, and calibrating operators and controls, as appropriate. Identification of each component to be checked will constitute a part of the maintenance plan. Confirmation of work completion by the person in charge of startup will be made prior to any purging and loading activity.

34.12.1.8 Personnel Organization

Experienced operating personnel, under the direction of a person with substantial prior experience in the operation of natural gas pipelines, will carry out the initial purging and pressuring of the pipeline system. It will be the responsibility of this person to coordinate all activities during the startup, including preparation of the overall plan, instruction of employees on the plan, as well as specific responsibilities and authority.

34.13 COMMUNICATION

The Communications criteria and plan outline is reviewed in Section 33, Communications System, of this Technical Information Supplement.

34.14 PIPELINE STARTUP

Startup-of the compressor and metering facilities will begin after mechanical completion. A check-off list and punch list procedure will be developed prior to startup of the system. Operating and maintenance personnel will be assigned to verify that thorough cleaning of equipment and piping has taken place. They will ensure that electrical circuits have been checked, that startup strainers are installed upstream of pumps and compressors, that all other points on the station checklist have been completed, and witness rotation check of motors. Before accepting each unit as being mechanically complete, lubricating oil, water/ glycol, and other system fluids will be added and each system leak tested. Initially, electric power will be established within the station so controls can be checked and lighting, heating, and other electrical needs met. The auxiliary generator will supply initial electric power. This unit will operate on diesel fuel and be able to supply full start-up power requirements. The main generators will then be started, which will permit the startup of the air compressors, and

other required mechanical components. The main generator turbines will be fired with diesel fuel prior to pressuring the pipeline.

The refrigeration condenser fans represent a major electrical load in each station. Each refrigeration train will be tested after charging with propane and after electrical power is available.

Gas will be introduced into the pipeline system after pressure testing has been completed. As the pipeline gas reaches each compressor and metering station, the station piping will be purged and leak tested. The gas filling the pipeline may be routed through the gas chillers for temperature-control.

When the pipeline system reaches the predetermined pressure, the main gas compressor at the next station will be started and brought on stream to provide the necessary driving force required to pack the line downstream of the station. This sequence will continue down through each compressor station until the Yukon meter station is reached. When the gas pressure in the Alaska Segment of the system exceeds that in the Canadian Segment, the valve between the two systems can be opened and the Alaska Segment of the pipeline system will be in service. The system pressure will be gradually raised to the full operating pressure at the discharge of each compressor station and the system will be brought to the initial throughput rate. This will substantially complete the construction phase of the project. During the startup phase, each station will be manned on a relatively continuous basis and controlled locally. The OCC will monitor and give operating instructions to each station, but the system will not be switched to the automated mode until all stations have been started and gas flow has stabilized. After the system is in the automated mode, continuous observance of each station will be maintained until system reliability has been confirmed.

34.15 TERMINATION AND RESTORATION

34.15.1 Termination of Facilities

It is currently planned that compressor stations, metering stations, communications stations and maintenance base facilities will be removed and their sites rehabilitated at the end of their useful life. All salvageable buildings, equipment, and aboveground materials will be disassembled and transported to the most convenient urban center to be sold. Typically, items to be salvaged are:

- Housing modules and contents
- Prefabricated major equipment buildings, shops, warehouses, utility buildings, and contents
- Power generation equipment
- Compressor turbine equipment
- Refrigeration equipment
- Aboveground piping and vessels

- Aboveground cabling and electrical and instrument devices
- Supervisory controls and telecommunications equipment
- Water supply and treatment equipment
- Solid waste incinerators and associated equipment
- Fuel storage tanks and dispensing equipment
- Distribution pumps and equipment
- Fencing material
- Recoverable scrap metal
- Unsalvageable and undesirable material, foundations, and debris will be removed and transported to acceptable disposal sites.

34.15.2 Termination of Pipeline

It is also currently planned that aboveground segments of the pipeline and related foundations, pipe supports, hangers, or pipe bridges will be removed and their sites rehabilitated at the end of their useful life. All salvageable buildings, intermediate block valve and piping assemblies, equipment, and other aboveground materials will be cut into sections or disassembled and transported to the most convenient urban center to be sold. Manmade structures used in workpad and access road construction, e.g., culverts, bridges, will be removed from the area for regrading and revegetation of the workpad.

34.15.3 Restoration

Areas that have been graded, filled, or otherwise disturbed during the course of the construction of the permanent facilities will be restored to satisfactory conditions at the end of their usefulness. Such restoration efforts will leave the affected area physically stable and minimally change the topography or drainage patterns until native vegetation reclaims the disturbed area. Restoration measures will include:

- Grading of areas to a stable geometry
- Installation of permanent erosion control structures
- Re-establishment of acceptable drainage patterns
- Redistribution of stripped material
- Revegetation of disturbed areas
- Reestablishment of native plant species
- Treatment of area designated as being visually critical

Revegetation may consist of both temporary and permanent measures. Temporary revegetation will consist of measures controlling erosion or siltation during construction of the permanent facilities. Permanent revegetation measures may be specified for slope

stabilization and restoration. Measures will be implemented in order to minimize erosion and visual impact and to enhance the re-establishment of native vegetation. Revegetation measures will include the following:

- Surface areas will be prepared to be revegetated leaving soil in a rough and friable condition.
- Permanent seeding will be used for final revegetation. Selected permanent seed mixes may consist of perennial grasses chosen for their similarity to native grasses and suitability to the climate.
- Surface protection will be applied, where needed, to retain moisture, dissipate raindrop energy, and hold the seed in place.