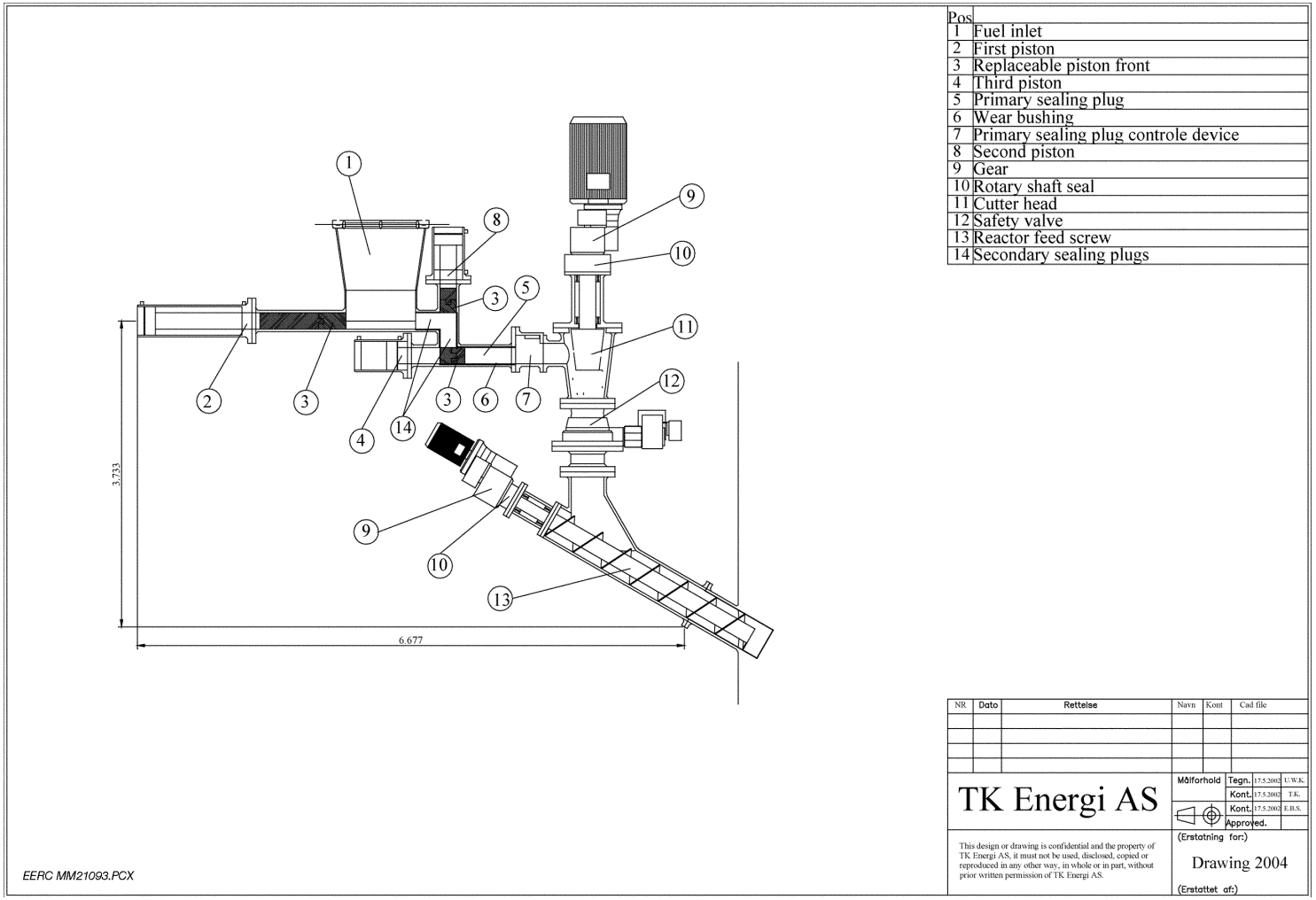

Figure 51. Schematic of TK Energi three-stage piston feeder for biomass.

The Sugar Research Institute (Mackay, Australia) is in the midst of development activities on a system for feeding sugarcane bagasse to pressurized gasifiers as part of biomass IGCC systems. Currently, the device has been developed to a capacity sufficient to feed a nominally 15-MWth gasifier (78). The organization envisions plants ranging in size from 50 to 120 MW_e to match the bagasse/cane trash supply produced currently by Australian sugar mills. The Institute is currently proceeding with the filing and procurement of international patents and is targeting a December 2002 completion time frame. The system is purported to provide truly continuous feed across the pressure boundary and does rely on the formation of bagasse plug to achieve high-pressure sealing. However, the feeder does not incorporate pistons or screw-type devices to achieve the plug formation. The formation and action of the "sealing plug" were not described, but there appears to be a potentially complex interplay between the mechanical design of an associated "chamber" and the flow behavior of the bagasse plug. There is no indication of testing with materials other than bagasse, nor is there information on the expected pressure boundary for fuel delivery.

The Posimetric Feeder, currently marketed in North America by Pennsylvania Crusher (79, 80) was developed by Stamet with financial assistance from the DOE Small Business Innovation Research Program. Its principal application has been for the nonpulsating metered feeding of coal to crushers in coal-fired power plants. The feeder uses a spool-shaped disk to move solids through a partial rotation to the discharge. Fuel is gravity-fed to the top inlet of the feeder. The feeder relies on "bridging" of the fuel with the spool to achieve movement of the fuel from the feed inlet to the discharge. The fuel moves at the same rotational speed as the spool, resulting in very low wear rates. Further, "packing" of the fuel supposedly results in eliminated or greatly reduced backflow of process gas. At the discharge opening, the feed "plug" disengages from the spool and proceeds at an angle up the discharge chute. Stamet indicates that the Posimetric Feeder has been demonstrated to deliver coal into a 210-psig atmosphere. The literature seems to imply that the presence of fines and proper control of particle-size distribution are necessary for producing a pluglike seal. However, discussions with the vendor indicate that more recent tests show difficulties at maintaining a gas seal in tests at 250 psig. Further, no systems were in place or being developed for application at pressures approaching 410 psig.

Non-Plug-Forming Feeders

Two functionally similar non-plug-forming feeders include the Ingersoll–Rand coaxial piston feeder and the Fortum piston feeder for solid fuels, shown in Figures 52 and 53, respectively. Both systems rely on the sealing of the piston surface against the material cylinder to prevent gas leakage or backflow of process gas. The Ingersoll–Rand system, whose development was halted in the mid 1980s, was designed for feeding coarse coal to systems operating at pressures up to 1500 psig (81). Figure 54 shows the five distinct sequences for one complete cycle of fuel feeding. In the first sequence, coal is gravity-fed from a special dosing hopper to the space between the *transport* and *gas exclusion* pistons. In the second sequence, the space between the pistons is pressurized with an inert gas to a pressure at or above that of the process. Gas is introduced through ports in the face of the gas exclusion piston. Both pistons then move at the same speed toward the discharge opening. In the third sequence, the pistons move to a point above the discharge allowing the coal to gravity-feed to the process. In the fourth sequence, the gas exclusion piston moves to bring its face against the face of the transport piston. Gas trapped between the piston faces is vented through the ports in

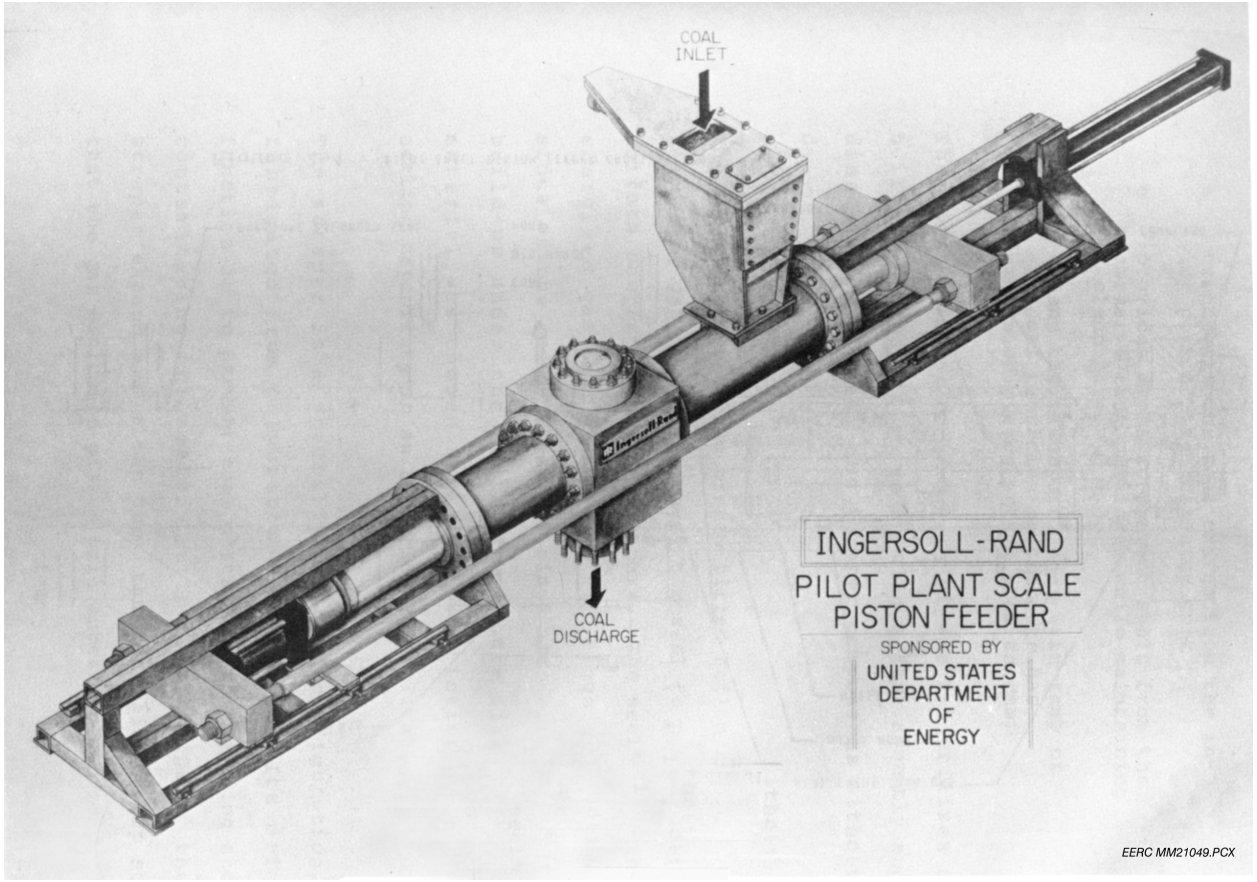

Figure 52. Schematic of Ingersoll–Rand coaxial piston feeder.

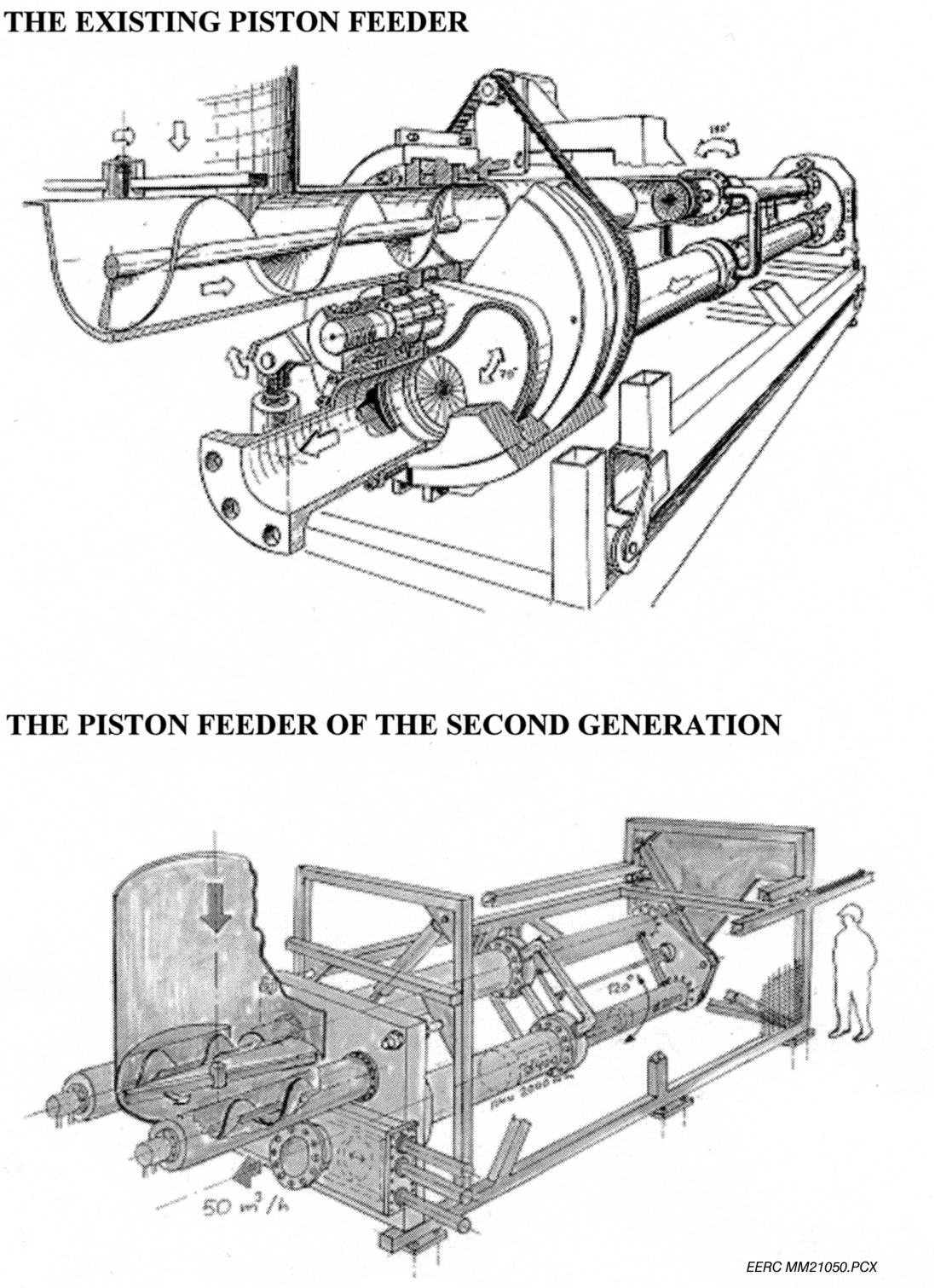

Figure 53. Artist conception of Fortum piston feeder for solid fuels.