

ELECTRICAL DEPARTMENT  
ANNUAL REPORT  
YEAR 1951

ATHENS MINE:

The hoisting equipment at this mine has served during the year with several short delays due to some armature and bearing difficulties with the skip hoist motor-generator set. Several broken risers in the armature of the skip hoist generator occurred, but hoisting operations continued with repairs being made over week end shutdown periods. Commutator irregularities and field coil failures of the skip hoist motor were repaired during week end stops in October. Some difficulties occurred with contactor parts for the cage hoist control panels due to obsolete equipment with no parts available. Some of these parts were made or rebuilt in our shops.

The air compressor equipment has been in good condition during the year with routine maintenance.

Installation of the 1500 HP, D.C. generator with the 450 HP synchronous motor and control panels to increase the D.C. haulage and scraper machine power supply was completed in the month of August.

Installation of larger cables in the shaft from the 10th level to the 6th level for D.C. power distribution was also completed. After the installation of larger cables in the shaft and into the 8th level drift, the D.C. load increased to a point which caused some overloading and heating of cables and distribution panels in the pump station. A new 500 MCM, twin conductor cable was put in from the generator bus to a new distribution center and the smaller circuit breakers and panels discontinued.

The pumping equipment has had routine repairs during the year with the exception of the Breitung Shaft pump which was partly destroyed when the headframe was cut down. A changeover of cables and pole line with a spare setup of transformers and control switches was necessary to get away from the falling headframe. This was completed July 10. On July 17, the structure was cut down and dropped in a direction which resulted in so much destruction of the lines and equipment that the shaft was filled with water before another setup for a 20 HP pump could be built. The two 20 HP pumps used for this shaft pumping job are stored at the mine and the pumping is now being done by a 10 HP Layne & Bowler pump borrowed from the Maas Mine.

The light and power job for the new dry house was completed in October. Wiring and service for a 110/220 volt lighting and heater circuit and a 220 volt, 3 phase power circuit were put in with transformers in the headframe. Two 3-conductor, #4 cables were buried in the ground from the dry house to the headframe. One 10 KVA transformer, No. 5090821, was taken from Negaunee Shaft to the Athens Mine for the required increase in capacity.

CAMBRIA-JACKSON MINE:

The hoisting equipment at this mine has given little trouble in 1951. All operations have been quite satisfactory since the installation of the 700 HP motor.

The spot welding of the rotor bars on the 250 HP Allis-Chalmers synchronous motor of the Laidlaw-Dunn-Gordon air compressor was completed in March. These bars were riveted several times but failed to hold proper contact, so spot welding was tried with good results. The field coils of the rotor were also tested, cleaned and repainted.

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CAMBRIA-JACKSON MINE: (continued)

The 200 HP, G. E. wound rotor motor for #1 Prescott pump on the 4th level was taken to the shops for a bearing and winding repair job. The motor foundation was also broken out and a completely new sole plate set up and concrete base made. The change made a great improvement in the gear and motor operation.

The 15 HP, 1750 RPM Louis Allis D.C. compound wound motor for the feeder conveyor at the winze was replaced with a 15 HP, 1150 RPM Westinghouse Type SK, D.C. motor for a more suitable speed range for loading the belt conveyor.

Several changes were made in the 250 volt D.C. haulage and U.G. power system. Another 500 MCM feeder cable was put into the winze from the 7th level to the 8th level and the 4/0 trolley cable extended into the 8th level drift 1000 feet.

Some minor repairs were made to the Crocker-Wheeler haulage generator windings and bearings. The two 150 KW, D.C. haulage generators in the engine house are in parallel operation continuously.

CLIFFS SHAFT MINE:

The 750 HP wound rotor motor for the "A" Shaft hoist was taken apart for inspection of band wires and coils in April and September, 1951, and they were found to be in good condition. Similar inspections were made of the "B" Shaft 750 HP hoist motor and it was also found to be in good condition. New worm gears and shafting repairs were made on both hoist controllers.

The 100 KW rotary converter and the 100 KW generator of the 250 volt D.C. haulage equipment in the engine house were overhauled during the year.

After several rotor bar failures on the synchronous motor of #1 compressor due to poor contact and burning connections, the riveting of these bars to the outer rings was discontinued in favor of the welding job which has proved a more permanent remedy for this difficulty.

Bearing renewals and winding repairs to the 200 HP motors of #1 and #2 Prescott pumps were made during the year.

The failure of one of the 2300 volt pump cables and a circuit breaker on surface at "A" Shaft occurred in June. The flashover also destroyed the "A" Shaft 2300 volt feeder cable for the scraper machine power circuit. Temporary cables were connected to restore the pumping. New cables were then laid in the ground from the circuit breaker near the blacksmith shop to the switches in the headframe, and a new 2/0, 2300 volt, 3-conductor cable installation made from the pole line to the oil circuit breaker and shaft cable connections in the headframe.

Changes requiring the removal of transformers, pole lines and cables for relocation of the distribution center and substation for surface power, "A" and "B" Shaft cables for underground 2300 volt power supply, and the main feeders for the engine house were completed. This work was done to clear the way for

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CLIFFS SHAFT MINE: (continued)

test holes near the engine house and to eliminate as much overhead wiring as possible. Transformers to make this change without power interruptions were borrowed from The Cliffs Power & Light Company and one new 10 KVA transformer was bought for the laboratory and sample crusher building power supply. The relocation of signal and haulage cables were also made at this time.

One new substation on the 5th level for 440 volt, 3 phase power distribution in the "B" Shaft area was completed in December. This is a 150 KVA substation with a setup of three 50 KVA transformers.

The 15 HP slip ring motor and controller with grid resistors formerly used with the screen and crusher equipment in the crusher house were set up with a small hoist for handling material in the air shaft. A cable for this 220 volt, 3 phase job was run in the ground from the transformer bank at the pellet plant to the shaft location.

One of the 50 HP wound rotor motors for the ore tram failed and was temporarily repaired during the stocking season. A complete set of coils was ordered and the stator winding rebuilt during the summer. The old rock tram motor is not in use and is stored at the mine. This is a duplicate of the ore tram motor and can be used in an emergency.

LLOYD MINE:

Several failures of the 500 HP skip hoist motor were the cause of some short delays due to open connections in the stator winding. Temporary repairs were made until October when the motor was taken apart and all the stator coils rewedged in the slots and a new tie ring put in and the coils tied and painted. A spare rebuilt bearing for the slip ring end of the motor was also put in at this time. Contact failures on the secondary control panel of the skip hoist also caused some stoppages. This control equipment is obsolete and parts are not readily obtainable from the manufacturer. It was, therefore, necessary to make connecting parts from spares used for Athens Mine cage hoist.

The haulage generators and equipment were kept in operating condition during the year with routine repairs.

Minor repairs were also made to the compressor equipment.

Bearing failures caused the burnout of several coils in the stator of the 50 HP Allis-Chalmers motor on the 2nd level water supply pump for the North Lake Location. The coils were cut out and the winding temporarily repaired in the shops. A complete set of coils was ordered and the stator rewound.

The 250 HP motor and line starter from the Mather Mine "A" Shaft 1000 ft. level were taken to the Lloyd Mine 5th level and installed with the 500 GPM, 3500 RPM centrifugal pump to be used in an emergency and while repairs are made to the Aldrich pump.

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MAAS MINE:

Several week end repair jobs were made on the skip hoist equipment during the year. The commutator of the motor developed irregularities from overheating and stalling due to overloads. Some repairs and changes were made to the lubricating system for the motor-generator set. Two bearing failures on the 1500 HP Allis-Chalmers generator occurred during the year. Some improvements were also made in the Ward Leonard control setup for this hoist.

Limit switches and signal lights were installed on the 5th level winze hoist for the travel limits of both cages.

Compressor motor repairs became costly the latter part of the year. The stator winding of No. 2, 438 HP motor failed and was repaired in October. This motor failed again November 2, due to a high voltage surge caused by a cross-up of a grounded Negaunee City arc lighting circuit with the primary or 2300 volt line. While a partial rewind was being made on the No. 2 compressor motor, the stator winding of No. 1 failed and burned beyond repair possibilities without a complete new set of coils. The coils were ordered from General Electric Company. While the pipe lines between the Maas Mine and Negaunee Shaft were being rebuilt, the air for both mines was supplied by one compressor at each end.

The D.C. haulage and scraper load had increased early in the year to a point beyond the capacity of the 830 ampere Allis-Chalmers motor-generator set. It was, therefore, necessary to arrange equalizer cables and connections for running this generator and one of the 400 ampere General Electric machines in parallel to carry the load until the installation of the larger motor-generator set on the 5th level could be completed.

Work on making room and concreting the base for the new 450 HP synchronous motor and the 2290 ampere D.C. generator on the 5th level near the winze was commenced in February. The installation of the motor-generator set with control and distribution panels was completed in September. Some difficulties occurred with falling ground due to heat from the machine. A shutdown was necessary to repair the timber and steel sets. The motor-generator set was started again and has been in operation since the first week of October. The D.C. voltage and general operating conditions were greatly improved with this installation which supplies all the necessary D.C. power without the aid of the machines in the engine house.

Bearing and winding failures were the cause of a tie-up of the 5th level 125 HP Westinghouse motor on the Prescott pump during the month of February. A broken end bracket occurred on this motor in April due to a bad line-up. The pump bearings were rebuilt and a new flexible coupling was built into the drive setup between the motor and pinion shaft and motor end bracket welded for temporary operation until a new one was made. This 2300 volt squirrel cage motor was bought from the Hill-Trumbull Mine in 1947.

A new 3-conductor, #2, 2300 volt, steel tape armored cable for power supply to the new haulage motor-generator set, winze hoist and the 6th and 7th level pumps was put in the 5th level drift from the pump station near the main shaft to the winze location. All connections for parallel operation of the new cable with the former cable setup from the shaft to the winze were completed.

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MATHER MINE "A" SHAFT:

Riser failures in the armature of the 1250 HP, D.C. skip hoist motor occurred and were repaired in October. A broken riser also occurred in the armature of the south generator of the skip hoist motor-generator set. These repairs were made during week end stops.

The 75 HP, 2300 volt, 3 phase motor for the underground sinking hoist failed June 21, and was brought to the General Shops for repairs. While in the shops, four coils were cut out of the stator winding and tests indicated that the motor would be all right until a new set of coils could be made. The motor was again taken underground but failed on a few trips. It was then decided to send the stator to the Industrial Engineering & Sales, Marquette, for a re-insulating job of the same coils and a complete rewind. The stator was sent to their shops in Marquette on June 26, and the job was completed July 10.

No costly changes or repairs were made to the motors or line starters of the compressors during the year.

Failure of the automatic line starters for the 300 HP synchronous motors of No. 1 and No. 2 Worthington pumps occurred in August. The difficulty was caused by a breakdown of selenium rectifiers in the control circuit. That part of the control equipment was replaced with A.C. magnetic contactors until renewal parts can be procured.

The installation of a new 500 MCM, twin conductor, 600 volt D.C. haulage cable in the shaft was completed from the shaft collar to the 5th level ignitron room. This cable, when completed to the D.C. panels in the engine house, will complete the tie between the ignitron and the haulage generator of the M-G set on surface.

The electrical equipment for the 7th level crusher and conveyor system, including a 150 HP wound rotor motor and control for the belt conveyor, a 20 HP, A.C. variable speed motor and control for the feeder conveyor, is on the job with installation about completed. The 100 HP, 2300 volt induction motor formerly used with the crusher in the headframe was set up for the underground crusher.

Installation of new transformers or substations for 440 volt power distribution underground were made with one 150 KVA, 3 phase station on the 5th level, one 150 KVA, 3 phase setup on the 6th level and two of the same size and type on the 7th level.

Some changes were made in the 2300 volt power distribution on surface for the shovel connections near the stockpiles. A metal enclosure for housing an oil circuit breaker with ground detectors and protection was set up with cables run along the trestle to three connecting stations.

MATHER MINE "B" SHAFT:

The new, improved type Westinghouse controllers were installed for the skip and cage hoists during the year to replace the controllers installed with the equipment.

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MATHER MINE "B" SHAFT: (continued)

That part of the Negaunee Shaft D.C. haulage equipment known as the No. 2 motor-generator set was taken to the Mather Mine "B" Shaft and installed in the 7th level. This consists of one General Electric 200 KW, 275 volt compound wound D.C. generator, one 300 HP, General Electric, 2300 volt synchronous motor with its line starting equipment and D.C. panels, switches and circuit breakers. While the D.C. voltage was built up on the generator, a failure occurred in one of the field coils due to an insulation breakdown between the shunt and series windings. The coil was sent to the General Electric shops for repairs while the motor-generator set was tied up for several weeks. A similar failure occurred again after a short run and repairs were made at the mine. Twin conductor, 4/0, concentric type, 600 volt cables for 275 volt D.C. distribution were extended from the 7th to the 8th level and from the 7th to the 10th level.

Installation of a 75 HP, 2300 volt Allis-Chalmers motor and Westinghouse starting compensator for a 600 gallon pump was made on the 7th level.

The setup of motors and controls for the stocking equipment on surface was made with one 30 HP, A.C., one 20 HP, D.C. for the pan feeders, one 7½ HP, A.C. motor for the small belt conveyor, and a 50 HP, 440 volt, A.C. motor on the long belt conveyor.

The following substations were added for underground 440 volt, A.C. power distribution:

- 2 - 150 KVA on the 6th level.
- 1 - 150 KVA on the 7th level.
- 1 - 150 KVA on the 8th level.
- 1 - 75 KVA consisting of 3 - 25 KVA transformers on the 10th level.

NEGAUNEE SHAFT:

Many difficulties arose in the shaft sinking operations due to high rope speed of the hoist with the 800 HP, A.C. motor and liquid rheostat control. The locked-in speed of the motor could seldom be used in that type of operation with the result that intermediate control points were used with the primary contacts opening under heavy loads which destroyed the contacts much too often. The flashing over at the liquid rheostat contacts plus the overheated, boiling solution also made trouble and consequent delays. The constant use of the brakes made necessary by these control difficulties was also destructive. After working under these conditions until May 1, it was decided to complete the D.C. motor and generator equipment and make the change to D.C. Ward-Leonard control as soon as possible. This was a difficult and costly installation on account of the A.C. equipment being in place and the building under construction. The change was made from May 26 to May 29. Some of the control and feeder panels and the exciter motor-generator set are temporarily set up while the hoist motor and large motor-generator set are permanently installed. Two bearing failures occurred on the motor-generator set but delays in operation were short and the control equipment is working very well.

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NEGAUNEE SHAFT: (continued)

The 438 HP synchronous motor of the Ingersoll-Rand compressor failed again on September 25. An insulation failure occurred in the stator coils near the motor connections and set fire to the winding. A complete set of coils was ordered from the General Electric Company and the stator rewind job was completed November 17.

SPIES MINE:

Several short delays occurred on account of power failures which did not affect the operations other than the pumping. A transformer failure occurred in the power bank which supplied the mine with 2300 volt, A.C. power. The power company replaced the old bank of 6 - 125 KVA single phase transformers with a newly built General Electric substation including a 1000 KVA, 3 phase transformer with circuit breakers and a two circuit feeder setup. The mine feeders were renewed with 250 MCM cables in two circuits placed in underground conduits from the engine house to the substation.

The installation of a 600 ampere oil circuit breaker and 500 ampere current transformers in the engine house on the 2300 volt shaft cable circuit was completed.

The new General Electric skip hoist controller on order since October, 1950, arrived and was set up and in operation during the month of July.

The stator winding of the synchronous motor on No. 1 haulage motor-generator set failed during a lightning storm September 26. One coil was cut out of the winding and operations continued with no difficulty until October 1 when another coil in the same slot failed. The second failure was probably due to burned insulation from the first break. The machine has been in continuous operation since October with no further coil difficulties.

The D.C. generator for field excitation of the synchronous motor of the Ingersoll-Rand compressor was repaired in the General Shops. Excitation current for the job was supplied by one of the haulage generators while this work was done.

Three 15 KVA transformers were moved into the 4th level drift about 1500 ft. and supplied with 2300 volt, 3 phase power by a #2, 3-conductor cable to supply A.C. power for the pumps near the air shaft while the stripping job in the shaft was done. This work also required 3000 ft. of #4, 3-conductor cable for 440 volt transmission from the transformers to the pumps. The feeders through the air shaft will be restored after the stripping job is completed.