



## LARGE REACTOR AND 7500/10,000 KVA TRANSFORMER FOR WIND TURBINE TEST FACILITY

Federal Pacific has reached another important milestone by building four 1833 amp, 695  $\mu$  Henry, three phase reactors, shown in Figure 1, which are the largest reactors built so far in the history of our Bristol facility. These reactors became a necessary addition to the four 7500/10,000 KVA transformers, built by Federal Pacific, to increase the transformer's impedance to a value of 36%. Each reactor required a significant number of gaps to develop the correct amount of inductance needed for the additional 24% of reactance.

Upon receiving a telephone call from the customer, Jim Arndt, Federal Pacific RSM, provided an extensive summary of Federal Pacific capabilities of building large magnetics, including 25 kV class transformers and MV reactors for which

our engineering personnel had just completed extensive training. Jim's knowledge of our capabilities and his presentation to the customer resulted in a privately negotiated, very large order that included four **reactors** and four 7.5/10.0 MVA **transformers** needed to serve a dynamometer wind turbine simulator test facility.

Each of Federal Pacific transformers is being used to feed a variable speed drive connected to a dynamometer for supplying the torque and forces, which simulate the mechanical stresses that large wind turbines must withstand, when supplying electricity into a utility grid system.

As Federal Pacific has built several very large 7500/10,000 KVA designs, this was the first instance of having to furnish transformers of this size with a very high impedance of 36% to limit the magnitude of possible fault currents to an acceptable value. Working with the customer, we decided to build each transformer with a 12% impedance on a 10 MVA base, and then increase its impedance by another 24%, using the reactor with the following characteristics:

FL Secondary amps	= 1833 Amps
The base Z Secondary	= 0.9923 ohms
Actual Z Transformer	= 0.1191 ohms
Actual Z Reactor	= 0.2382 ohms
Inductance Reactor	= 695 $\mu$ Henries
%IZ Trans + Reactor	= 36.01%

The reactor values shown above are calculated per standard transformer engineering reference books.



Gaps in Core Leg

Figure 1

Federal Pacific provided almost precisely what the customer wanted to limit the fault current to values that would not cause damage to this transformer or his other system components.

The transformer, shown in Figure 2, is rated 23,900 volts delta for the high voltage winding and 3150 volts delta for the low voltage winding. Based on extensive harmonic analysis by the customer, who is installing a filter to eliminate most of the harmonics in the circuit, the transformer needed to be rated for K-4 harmonic duty.

With the emphasis on renewable energy production, we believe that there will be additional testing facilities needed to confirm the expected performance of wind turbines, especially as the wind turbines are designed for higher power capacity outputs.

Federal Pacific is very proud of the transformer and reactor system provided for this application.

We are especially confident that we can furnish your low voltage and medium voltage reactor requirements having very nearly the precise values specified for the applications that are being installed.



*Figure 2*

