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COMPLEXITY IN ISFA (in-service fluid analysis)

Part XVI

Evaluating developments in holistic condition monitoring.

LET'S SWITCH GEARS A BIT and discuss new developments in holistic condition monitoring, which is beginning to make its way to the CM arena. First, we'll review what's been happening since the beginning of the 21st Century and is now beginning to solidify and gain traction. ISFA became a 3-tiered logistical process in terms of where performed:

1. **Tier-1 ONLINE** (the ultimate goal of ISFA)
2. **Tier-2 ONSITE** (the burgeoning methodology to now support Online)
3. **Tier-3 OFFSITE** (traditional and original oil analysis (ISFA now, please)).

I've several times waxed strong on this development because I view it as the major paradigm shift in ISFA—indeed, in CM, since 1960 when the semi-automated UV spectrometer (Walter Baird) and, shortly thereafter, adapted to commercial ISFA. There were actually three consequences; a fourth is in process, although it will probably not clarify for, perhaps, a decade, but possibly a lot sooner:

1. **Consequence One:** Tier-1 provides instant gratification for numbers of fault conditions or possible trauma. ISFA gained parity with vibration when Tier-1 was viable. This will mean additional ISFA demand, particularly in the industrial sector where vibration (circa early 1970s) got a huge head start on ISFA as a routine CM process. There are more industrial component sumps than in any other sector/application. ISFA was always present but not with the same fervor accorded VIB because it wasn't real time.

2. **Consequence Two:** While those of us who have at least one foot planted in ISFA as the most informative CM tool, generally, there is a further reaching consequence of having real-time VIB and ISFA. Yes, one can compare *both* in real-time. This synergy is, of course, a result of a pathological process from vendors of CM-assisting instrumentation—the recognition that answers are desired and occasionally needed in real-time. ISFA sensors (Tier-1) simply lagged until they were capable of being ruggedized, or else they'd have made their presence a decade or two earlier. It is going to be an interesting exercise to begin to reduce, compare and correlate streaming data from two potentially complementary techniques.

3. **Consequence Three:** Tier-2 testing has become increasingly popular because cleverly designed and implemented bench instruments with small footprints are displacing oft-cumbersome, chemistry oriented, time-consuming, labor-intensive tests. These Tier-2 instruments are becoming increasingly more sophisticated, and it is simply a matter of time before most, if not all, of the important routine tests that Tier-3 labs perform are simulated or duplicated with sufficient efficacy such that Tier-3 sampling will be negatively affected, certainly as it pertains to routine test suites for CM.

   But Tier-2 testing now has an additional and potentially huge role, thanks to Tier-1. Tier-2 can be effectively used to vet Tier-1 alarms and excursions, adding depth and nuance to decision-making. I would personally not shut down a machine solely on the basis of Tier-1 ISFA alarms (though I would if I had a VIB alarm of equal severity that syncs with the ISFA alarm)—therein lies the synergy and corroboration with both techniques in real-time mode, almost a slam-dunk.

Nevertheless, when ISFA and VIB might not generate simultaneous alarms, the notion of vetting the ISFA alarm with additional testing minutes, thereafter, is an exciting addition to the CM process. More Tier-2 instruments will be purchased for this express purpose.

Tier-1 ISFA injected new and additional impetus for Tier-2. If Tier-2 were not available whatsoever, a Tier-1 alarm would virtually force an out-of-turn sample to be sent to an offsite Tier-3 lab—would not the wait/delay be agonizing? Tier-2, on the other hand, is just a few hundred yards away, and a sample could be hand-delivered and analyzed in short order. Clearly, Tier-2 usage will be partially driven by Tier-1 alarms.

4. **Consequence Four:** Though not immediately but with erosion over time, Tier-3 labs will be increasingly pressured to maintain their bread-and-butter routine testing volume as Tier-2 takes increasingly larger chunks of it away.

   It would seem logical for Tier-3 entities to wean themselves from commoditized low-cost testing suites as a planned endeavor at some level of awareness in order to prepare for the inevitable in this regard, but it doesn't have to be conducted as a fire drill. It's an opportunity to anticipate what's coming and segue into an area that allows Tier-3 to maintain relevancy in ISFA. This would include, as some labs already perform, more complex and expertise oriented testing such as ferrography, SEM and filter debris analysis.

Next column I will describe and pictorialize an exciting new installation at the U.S. Department of Energy's National Renewable Energy Laboratory involving several ISFA sensors, complemented by new-generation acoustic emission sensors, as installed on a wind turbine gearset, wherein several CM modes are in play.

The objective will be to gather all these, heretofore, disparate data into a single intelligent agent for analysis and evaluation, fulfilling the second consequence of Tier-1 ISFA, that of melding ISFA data with other CM data such as VIB, routine particle counting (along with Ferrous debris counting at the sensor level) and acoustic emission. There is surely some promise of synergy and corroboration of all these data, and I'm personally looking forward to participating in this exercise.

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