*Transactions of the Korean Nuclear Society Autumn Meeting*
*Gyeongju, Korea, November 2-3, 2006*

# Analysis for improvement of monthly test method of EDG at Uljin 1 & 2

Kwang Hee Choi a, Jea Hun Yun b

*a Korea Electric Power Research Institute, Munji-Dong, Yusong-Gu, Taejon, Korea, khchoi@kepri.re.kr*
*b Korea Power Engineering Company, Youngin, Gyeonggi-do, Korea, yunjh@kopec.co.kr*

## 1. Introduction

The monthly test method of Emergency Diesel Generator(EDG) of Uljin 1&2 unit is differ from that of other PWR in Korea. Current monthly test of EDG at Uljin 1&2 unit has been performed by loading on real demand bus at 35% power level. But EDG of other PWR has been tested by synchronization to power transmission at 100% power. By the way, SACM that is manufacturer of EDG of Uljin 1&2 unit recommend the EDG should be operated at minimum 50% power to protect imperfect combustion.

In this paper, it is evaluated and analyzed that the problem of overload on EDG will be happened due to demand load of safety and non-safety buses when test method of EDG is changed from current real loading to synchronization.

## 2. Analysis of EDG monthly test by synchronization

### *2.1 Evaluation of onsite electric power system*

Onsite power system diagram is shown as figure 1-1.

Unit Auxiliary Transformer(UAT) are used for power supply at startup and full power operation. Each of UAT and SAT(Standby Auxiliary Transformer(SAT) are installed separately per unit. SAT is automatically transferred from UAT for offsite power supply when normal power supply by UAT is not available. Type of auto transferring is "slow transfer" that have a 1.5 second as transfer interval time

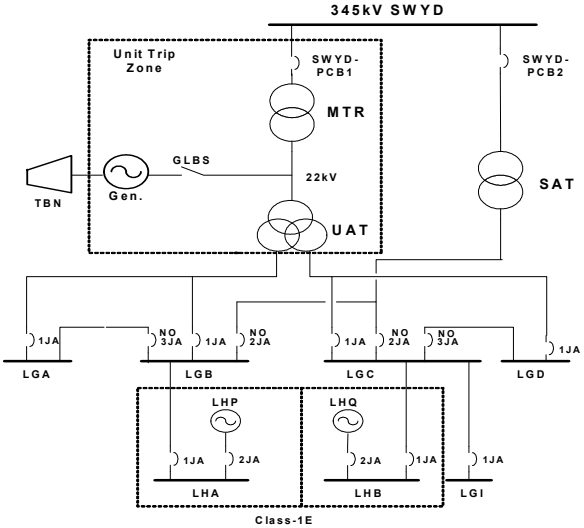


Figure 2-1 Schematic Diagram of Onsite power system of Uljin 1&2

It is distinguishing feature that power of safety buses (LHA/LHB) are supplied from non-safety buses ((LGB/LGC) not directly from UAT or SAT. By the way, normal power of Class 1E buses at Uljin 3&4 and Yonggwang 1&2 unit are directly supplied from UAT and SAT respectively.

| | Uljin 1&2 | Uljin 3&4 | YGN 1&2 |
|---|---|---|---|
| **UAT (ea/unit)** | 1 | 2 | 2 |
| **SAT (ea/unit)** | 1 | 2 | 2 |
| **Station voltage(High)** | 6.6kV | 13.8kV, 4.16kV | 13.8kV, 4.16kV |
| **EDG rating** | 4,500kW | 7,000kW | 7,000kW |
| **Auto power transfer (Class 1E)** | slow transfer | slow/fast transfer | none |
| **Normal source of Class 1E** | Non IE Bus | UAT | SUT |
| **UAT 2nd relay Trip at Unit Trip** | No signal | Trip | Not application(SUT) |
| **Required Load of EDG /Output[MVA]** | 51.0 / 2.8* | 8.6 / 8.7 | 6.4 / 8.8 |
| **Possibility of overload on EDG** | Yes | No | No |

* 50% power of EDG

Table 2-1 Electric system configuration and evaluation of possibility of overload on EDG

### *2.2 Evaluation of possibility of overload on EDG*

Unit trip is defined that 345kV Curcuit Breaker, field switch and turbine are tripped when main generator or main/aux transformer related relay are actuated.

2.2.1 In case of unit trip during normal operation

When unit is tripped at normal operation, power on each load connected with buses under UAT is not supplied from normal power sources. Therefore, under voltage relay of LGB/LGC buses are actuated on a signal of LOV(Loss of Voltage) of buses(LGB/LGC). And then electric power of non-safety buses(LGB/LGC) is supplied from SAT by auto slow transfer.

EDG come to start automatically by under voltage relay of safety buses(LHA/LHB). But if auto transfer is successfully done, supply circuit breaker(LHA/LHB 002JA) of EDG is not cut in

2.2.2 In case of unit trip during tested EDG is operating by synchronization

According to unit trip, EDG under operation for test should be burdened as much as all demand load on buses both LGB(LGC) and LHA(LHB). At this time EDG is overloaded because EDG output(2.8MVA at

50% power) is less than demand load of houseload(51.0MVA).
So under voltage and under frequency on buses are expected. And EDG is expected to overload during transition time.

### *2.3 Analysis of effect on protection relay of EDG overload*

For protection of overload of EDG, three protection relay that are UVR(Under Voltage Relay), FR (Frequency relay(Under/Over)) and OCR(Over Current Relay) were provided. For actuation process of each case of protection relay due to overload on EDG, it is analyzed by simulation using computer program ETAP(Electrical Transient Analyzer Program) during 5.0 second after event.

2.3.1 In case of Unit Trip

Among these protection relay, OCR is first actuated to cut off circuit breaker LHA(or LHB) 001JA.

Over current of EDG is shown as Figure 2-3.

2.3.2 In case of 345kV SWYD PCB Trip

While output of main generator is suddenly reduced, frequency of system will rise. Over frequency relay are first actuated to cut off circuit breaker LHA(or LHB) 001JA. and that result is shown as Figure 2-4

2.3.3 In case of Main Generator Trip

Current of EDG due to trip of main generator suddenly rise. OCR is first actuated to cut off circuit breaker LHA(or LHB) 001JA. Over current is shown as Figure 2-5

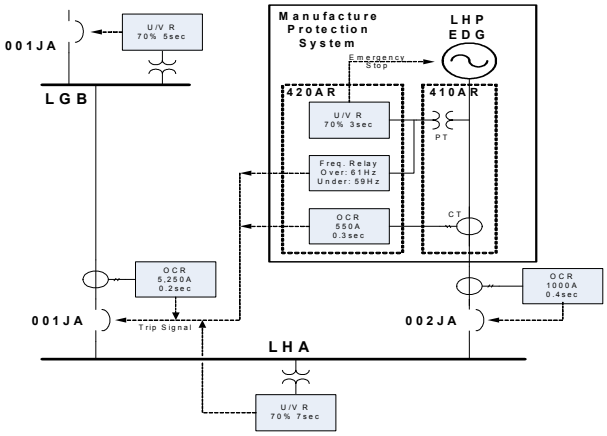


Figure 2-2 EDG Protection relay system of Uljin unit 1&2

| Event/relay | UVR | FR | OCR |
|---|---|---|---|
| Unit Trip | 3rd | 2nd (UFR) | 1st |
| 345kV SWYD PCB Trip | No accuated | OFR | No accuated |
| Main Gen. Trip | No accuated | No accuated | Accutated |

Table 2-2 “Result of simulation of protection relay of EDG”

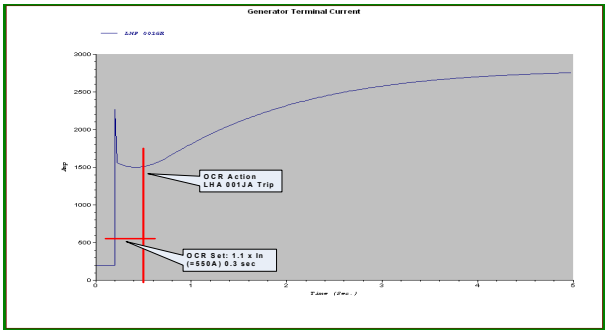


Figure 2-3 LHP EDG current transient at Unit Trip

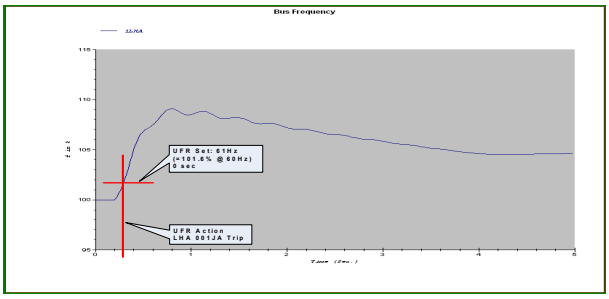


Figure 2-4 “LHA buses frequency at 345kV PCB Trip”“

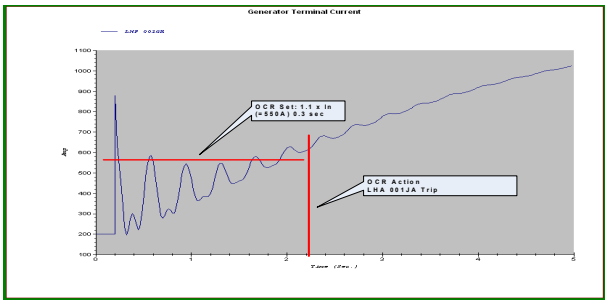


Figure 2-5 “LHP current transient at Main Generator trip”

## 3. Conclusion

As to recommendation of manufacturer of EDG of Uljin 1&2, we evaluated EDG monthly test method that operating power level can be changed from 35% loading to minimum 50% load by synchronization. In this study, we found EDG of Uljin 1&2 can be overloaded in case of unit trip during test of EDG because safety buses is connected with non-safety buses. Also EDG can be protected properly in several case simulation on three protection relay actuation. According to this analysis, EDG monthly test method can be revised by synchronized method at minimum 50% power level.

## REFERENCES

1. Uljin 1&2 FSAR Chaper 8, 16 KHNP
2. EDG O&M Manual of Uljin 1&2, SACM
3. Technical Report “Consulting report for revision of monthly test of EDG of Uljin 1&2” KEPRI. 2006”