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ETAP을 이용한 하나로 냉중성자원의 전력계통 분석

Analysis of the Electric Power System of HANARO Cold Neutron Source using ETAP

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제출문

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이 보고서를 2004년도 “냉중성자원 시설계통개발” 과제의 기술보고서로 제출합니다

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요약문

전력계통의 계획, 설계 및 운영을 위해서는 계통의 성능, 신뢰성, 안전성 및 경제성에 대한 연구를 필요로 한다. 전력조류분석, 케이블 전류용량, 단락전류분석, 보호협조, 안정도 분석 및 전동기 기동분석은 반드시 수행되어야 한다. 냉중성자원(Cold Neutron Source, 이하 CNS) 전력계통에서 변압기의 탭 선정 및 전력계통의 최적 운전 조건을 결정하기 위하여 다양한 운전 조건에 따른 각 모선에서의 전력조류분석, 모터기동분석 및 단락전류 분석을 하였다. 이들 해석은 전력계통 설계 및 해석 프로그램인 ETAP(Electrical Transient Analyzer Program, Ver. 5.0.0)을 이용하여 수행하였다.

전력 조류의 분석은 컴퓨터 모사에 의한 최적 운전 조건을 추적하여 가장 합리적인 운용이 될 수 있도록 하기 위함이다. 전력조류 분석은 다음의 항목들에 대하여 수행하였다.

-. 연구소 변전소로부터의 공급 유효전력, 무효전력량
-. 모선의 전압강하
-. 모선의 유효전력, 무효전력 흐름 분석

모터의 기동전류는 정상 전 부하전류의 5~10배이다. 모터의 기동토크는 인가전압의 제곱에 비례하므로 전압강하가 크면 기동토크를 발생시킬 수 없을 뿐 아니라 운전 중인 모터는 정지할 수 있다. 예상되는 CNS의 최대용량 모터(냉동기용 공기압축기용 모터)를 제외한 전 부하 운전 중 최대 용량 모터를 기동시켜 각 모선 및 모터 단자전압 강하를 확인하였다.

단락전류분석은 사고발생 후 계통에 흐르는 예상 사고전류를 결정하기 위한 것이다. 일반적으로 계획단계에서는 기기의 배치, 계통전압의 결정, 변압기 및 케이블 용량 결정 등을 위해 수행되며, 운전 중인 계통에서는 모터부하의 증설, 계통의 변경, 보호협조의 재구성 및 차단기의 용량 검증에 사용된다.

단락전류의 크기 및 지속시간은 계통의 특성에 종속되며, 사고전류를 감지하고, 사고를 차단, 격리시키기 위한 보호시스템이 요구된다. CNS 전력계통의 보호설계를 위한 최대 단락용량을 결정하고 차단기, 스위치기어의 선정 및 보호계전기 설정을 위한 정보를 제공하기 위하여 단락전류 분석을 하였다.

SUMMARY

The planning, design, and operation of electric power system require engineering studies to assist in the evaluation of the system performance, reliability, safety and economics. The studies most likely to be needed are load flow studies, cable ampacity studies, short-circuit studies, coordination studies, stability studies, and motor-starting studies. This technical report deals with the load flow study, motor starting study and short circuit study for CNS(Cold Neutron Source) power system using ETAP(Electrical Transient Analyzer Program) to determine the optimal operating condition.

The analysis of load flow is for searching the optimal operation condition by computer simulation. The analyzed items are as follows.

- Active and reactive power from KAERI substation
- Voltage drop on Bus
- Analysis of load flow of active power and reactive power on Bus

The motor starting current of most ac motors is several times normal full load current. Motor starting torque varies directly as square of the applied voltage. If the terminal voltage drop is excessive, the motor may not have enough starting torque to accelerate up to running speed. Running motors may stall from excessive voltage drops.

Short-circuit studies are done to determine the magnitude of the prospective currents flowing throughout the power system at various time intervals after a fault occurs. Short-circuit studies can be performed at the planning stage in order to help finalize the system layout, determine voltage levels, and size cables, transformers, and conductors. For existing systems, fault studies are necessary in the cases of installation of extra rotating loads, system layout modifications, rearrangement of protection equipment, verification of the adequacy of existing breakers.

목 차

제1장 서론

전력계통의 계획, 설계 및 운영을 위해서는 계통의 성능, 신뢰성, 안전성 및 경제성에 대한 분석 및 검토를 필요로 한다. 전력조류분석, 케이블 전류용량, 단락전류분석, 보호협조, 안정도 분석 및 전동기 기동분석은 반드시 수행되어야 한다. CNS의 전력계통은 전력공급의 신뢰성 및 안전성을 보장하며 운전 및 유지보수의 편리성 및 경제성을 고려하여 설계하였다. 냉중성자원(Cold Neutron Source, 이하 CNS) 전력계통에서 변압기의 탭 선정 및 전력계통의 최적 운전 조건을 결정하기 위하여 다양한 운전 조건에 따른 각 모선에서의 전력조류분석, 모터기동분석 및 단락전류 분석을 하였다. 이들 해석은 전력계통 설계 및 해석 프로그램인 ETAP(Electrical Transient Analyzer Program, Ver. 5.0.0)을 이용하여 수행하였다.

1) 전력조류분석

전력계통의 설계 시에는 전압강하가 부하의 정상운전에 지장이 없는가를 살펴보아야 하며 전압강하의 계산법으로는 전류법, Per Unit Impedance Ratio법, 전력조류(Load Flow) 계산법 등이 있다. 전력조류 계산법을 이용하면 전압강하뿐 아니라 각 Bus에서의 전력량, 전력 손실 및 전류 등을 알 수 있기 때문에 전력손실을 최소화 하기 위한 최적운전 조건을 결정하는데 많이 사용되고 있다. 전력조류 계산법으로는 Gauss 반복법, Gauss-Seidel 반복법, Newton-Raphson법 등이 있으나 본 보고서에서는 전력계통 설계 및 해석 프로그램인 ETAP을이용하여 Newton-Raphson법으로 전력조류를 계산하였다.

2) 모터기동분석

모터의 기동전류는 정상 전 부하전류의 5~10배이다. 모터의 기동토크는 인가전압의 제곱에 비례하므로 전압강하가 크면 기동토크를 발생시킬 수 없을 뿐 아니라 운전 중인 모터는 정지할 수 있다. CNS의 최대용량 모터(냉동기용 공기압축기용 모터)를 제외한 전 부하 운전 중 최대 용량 모터를 기동시켜 각 모선 및 모터 단자전압 강하를 확인하였다.

3) 단락전류분석

단락전류분석은 사고발생 후 계통에 흐르는 예상 사고전류를 결정하기 위한 것이다. 일반적으로 계획단계에서는 기기의 배치, 계통전압의 결정, 변압기 및 케이블 용량 결정 등을 위해 수행되며, 운전 중인 계통에서는 모터부하의 증설, 계통의 변경, 보호협조의 재구성 및 차단기의 용량 검증에 사용된다.

단락전류의 크기 및 지속시간은 계통의 특성에 종속되며, 사고전류를 감지하고,

사고를 차단, 격리시키기 위한 보호시스템이 요구된다. CNS 전력계통의 보호설계를 위한 최대 단락용량을 결정하고 차단기, 스위치기어의 선정 및 보호계전기 설정을 위한 정보를 제공하기 위하여 ETAP을 이용하여 단락전류 분석을 하였다.

제2장 전력계통의 분석

제1절 전력계통의 구성

CNS는 연구소 변전소로부터 6.6kV의 전력을 공급받으며 전원의 신뢰도에 따라 아래와 같이 4등급으로 나누어져 있으며 부하의 안전성 정도에 따라 전력을 공급하고 있다.

① 4급 전력: 상용교류 전력으로 한전전력
② 3급 전력: 4급 전력에 비상 디젤 발전기가 연결된 교류전력
③ 2급 전력: 무정전 교류전력으로 3급 전력에 축전지가 연결된 교류전력
④ 1급 전력: 무정전 직류전력으로 3급 전력에 축전지가 연결된 직류전력

주요 모선 전압은 고압모선전압은 6,600V, 저압 모선전압은 460V로 설계하며 비전동기 부하의 정격전압은 계통전압과 같도록 설계한다. 전동기의 기동을 포함한 부하의 사용으로 전압강하가 발생되며 이 경우에도 안정적으로 전동기가 운전될 수 있도록 전동기의 정격전압은 모선전압보다 약 5% 낮게 결정한다.

① 1Hp 이상 250Hp 미만의 전동기: 삼상 440V
② 1Hp 미만의 전동기: 단상 110V

전력계통을 제외한 모든 전력계통은 IEEE std 141(Recommended Practice for Electric Power Distribution for Industrial Plants), ANSI/NFPA 70(National Electric Code) 및 기타 국내 전기 관련 규격에 따라 설계하였다.

제2절 전력조류분석

컴퓨터 모사에 의한 전력조류분석은 최적 운전 조건을 추적하여 가장 합리적인 운용이 될 수 있도록 하기 위함이다. 전력조류분석은 역률개선을 위한 최적의 커패시터 선정, 돌입부하 또는 갑작스런 부하제거를 위한 계통전압결정 등에도 유용하다. 본 보고서에서는 전력조류분석으로 CNS 전력설비의 전압 및 전류 분포에 대한 각 전력설비의 안전 운전 허용범위 및 모선전압이 규정 범위 이내인가 검토하였다. 전력조류 계산법으로는 Gauss 반복법, Gauss-Seidel 반복법,

Newton-Raphson법 등이 있으나 본 보고서에서는 전력계통 설계 및 해석 프로그램인 ETAP을이용하여 Newton-Raphson법으로 전력조류를 계산하였다. Newton-Raphson법에 의한 전력조류계산의 일반식은 다음과 같다.

$$\begin{bmatrix}\Delta P\\ \Delta Q\end{bmatrix}\begin{bmatrix}J_1 & J_2\\ J_3 & J_4\end{bmatrix} = \begin{bmatrix}\Delta\delta\\ \Delta V\end{bmatrix}$$

ΔP, ΔQ는 유효전력 및 무효전력의 조건값과 계산값사이의 벡터차, $J_1 \sim J_4$는 Jacobian matrix, ΔV는 모선 전압의 크기벡터, $\Delta\delta$는 모선 전압의 각이다. Newton-Raphson법은 초기의 모선전압에 많은 영향을 받으므로 Gauss-Seidel 반복법에 의해 초기값을 구한 후 전력조류 분석을 하였다.

전력조류 분석은 다음의 항목들에 대하여 수행하였다.

-. 연구소 변전소로부터의 공급 유효전력, 무효전력량
-. 모선의 전압강하
-. 모선의 유효전력, 무효전력 흐름 분석
-. 계통 손실
-. 변압기 용량

1. 가정(Condition of Calculation and Assumption) 및 기준

CNS 전력계통의 전력조류분석을 위하여 다음의 가정을 하였다.

1) 연구소의 주변전소 22.9kV 계통의 단락용량은 1000MVA, X/R=15로 하였으며 전압변동률은 한국전력의 전압유지 범위인 ±4.5%로 한다.
2) 전동기의 기동전류는 전부하 정격전류의 6.5배를 적용하였다.
3) 계통의 최대 수요부하는 운전부하의 100%로 하였다.
4) 전선에 의한 전압강하는 인입 케이블만 고려하였으며 각 부하측 케이블에 의한 전압강하는 케이블 사이징 계산에서 고려한다.
5) 연구소 주변전소의 22.9/6.6kV 변압기의 % 임피던스는 7%로 가정하였다.
6) 이와 같은 가정으로 계산하였을 때 다음의 기준을 만족하여야 한다.
   -. 정상 운전 시 기기 또는 모선의 단자전압은 정격의 90% 이상 유지

2. 입력데이터

계산을 위한 입력데이터는 다음과 같다.

1) 인입 케이블 (Cu/XLPE, 300mm^2)

임피던스 Z=0.023257 + j 037405 (Ω/km)

2) 변압기

가. 연구소 주 변압기

-. 전압 : 22.9kV/6.6kV

-. 용량 : 10MVA

-. 허용오차 : ± 7.5 %

-. %Z : 7

나. 부하반의 변압기(부속기기동, 실험동)

-. 전압 : 6.6kV/460V

-. 용량 : 1000kVA

-. %Z : 5.75

다. 부하반의 변압기(연구동)

-. 전압 : 6.6kV/460V

-. 용량 : 1500/2000kVA

-. %Z : 5.75 @ 1500kVA

3) 전력조류 분석에서는 CNS에 예상되는 모든 부하를 고려하였으며 예비부하 및 조명부하는 계산에서 제외하였다. 계절부하는 용량이 큰 계절 부하를 선택하였다. 전력조류 분석에 사용된 부하요약은 표1과 같다.

표 1 전력조류분석 부하요약

구분	최대 수요 부하				비고
	Description	부하용량 (kVA)	부하종류	운전상태	
CB-541-E-V101 (Load Center)	Motor Loads	749	Motor	Running	Lump Sum
	Static Loads	97	Static	Running	Lump Sum
	소 계	**846**			
KM-541-E-V201 (Load Center)	Motor Loads	318	Motor	Running	Lump Sum
	Static Loads	282	Static	Running	Lump Sum
	소 계	**600**			
KM-541-E-V301 (Load Center)	Motor Loads	306	Motor	Running	Lump Sum
	Static Loads	46	Static	Running	Lump Sum
	소 계	**352**			

3. 전력조류 계산결과

전력조류 계산 결과는 Appendix 1(page 7~8)에 자세히 나타나 있다. 다음의 표 2는 CNS의 모든 부하를 투입한 상태에서의 전력조류 분석결과를 요약한 것이다. Load Flow에서 음의 수는 Load flow가 “To”에서 “from”으로 들어오는 것을 의미한다. 이 경우 연구소 주변전소는 CNS에 유효전력 1.953MW, 무효전력 1.341Mvar을 공급하고 있다. 이를 피상전력으로 나타내면 2.369MVA이며 전류는 약 210A이다.

다음 표 3의 단자전압은 CNS의 전부하가 정상운전 상태에서 ETAP을 이용한 컴퓨터 시뮬레이션 결과이다. 시뮬레이션 결과 모든 부하가 정상운전 시 모선 및 전동기 단자전압은 정격의 90%이상을 유지함을 알 수 있다. 전압강하가 가장 큰 모선은 부속기기동 부하반으로 초기상태보다 4.83% 낮다.

표 2 전력조류분석결과

BUS		Voltage		Load Flow	
From	To	정격	% 전압	MW	Mvar
연구소 주변전소 변압기 1차 (Swing 모선)	연구소 주변전소 변압기 2차	22.9kV	100.00	1.956	1.384
연구소 주변전소 변압기 2차	CB-531-E-Z001	6.6kV	98.88	1.953	1.341
CB-531-E-Z001	연구소 주변전소	6.6kV	98.65	-1.950	-1.338
	CB-541-E-V101			0.861	0.709
	CB-541-E-V201			0.740	0.368
	CB-541-E-V301			0.349	0.261
CB-541-E-V201	CB-531-E-Z001	0.46kV	93.83	-0.848	-0.636
CB-541-E-V201		0.46kV	96.87	-0.737	-0.341
CB-541-E-V301		0.46kV	96.82	-0.347	-0.250

표 3 전력조류분석 결과요약(전압강하)

BUS		초기상태 단자전압 (% 전압)	정상운전 단자전압 (% 전압)	비고
BUS ID	정격 전압			
CB-531-E-Z001	6.6kV	98.7	98.65	스위치기어
CB-541-E-V101	0.46kV	98.7	93.83	부하반
CB-541-E-V201	0.46kV	98.7	96.87	부하반
CB-541-E-V301	0.46kV	98.7	96.82	부하반
CB-542-E-E001	0.46kV	-	93.83	전동기제어반
CB-542-E-E002	0.46kV	-	96.87	전동기제어반
CB-542-E-E003	0.46kV	-	96.87	전동기제어반
CB-542-E-E004	0.46kV	-	96.82	전동기제어반
CB-542-E-E005	0.46kV	-	96.82	전동기제어반
CB-540-E-L101	0.22kV	-	93.83	조명 판넬
CB-540-E-L102	0.22kV	-	96.87	조명 판넬
CB-540-E-L103	0.22kV	-	96.82	조명 판넬

표 4 전력조류분석 결과요약(변압기 손실)

부하반	변압기용량 (kVA)	손실		% 모선전압
		피상전력 (kVA)	유효전력(kW)	
			무효전력(kVAR)	
부속기기동	1000	73.47	12.5	93.8
			72.4	
실험동	1500	30	3.8	96.9
			26.7	
연구동	1000	11.26	1.9	96.8
			11.1	

각 부하반 변압기에서의 손실은 부속기기동 73.47kVA, 실험동 30kVA, 연구동 11.26kVA임을 확인하였다(표4). 스위치기어 및 각 부하반에서의 전력조류 결과 단선도는 그림 1, 2, 3, 4에 나타나있다.

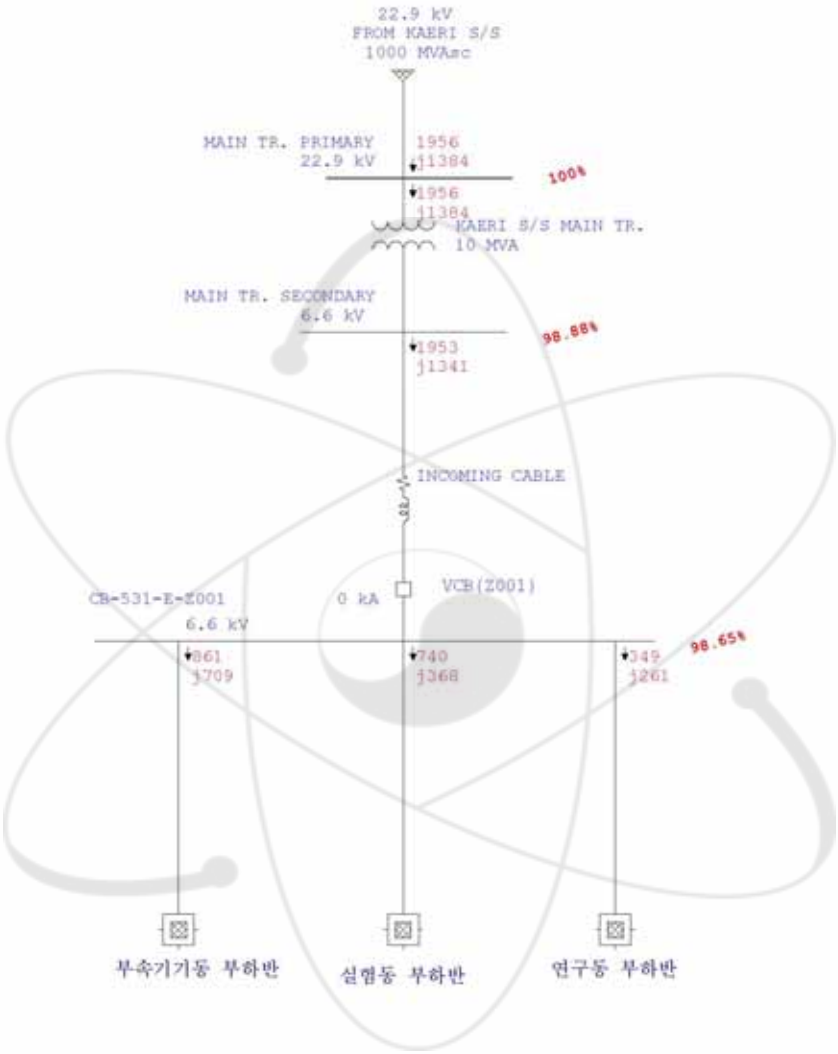

그림 1 전력조류분석 결과 (스위치기어)

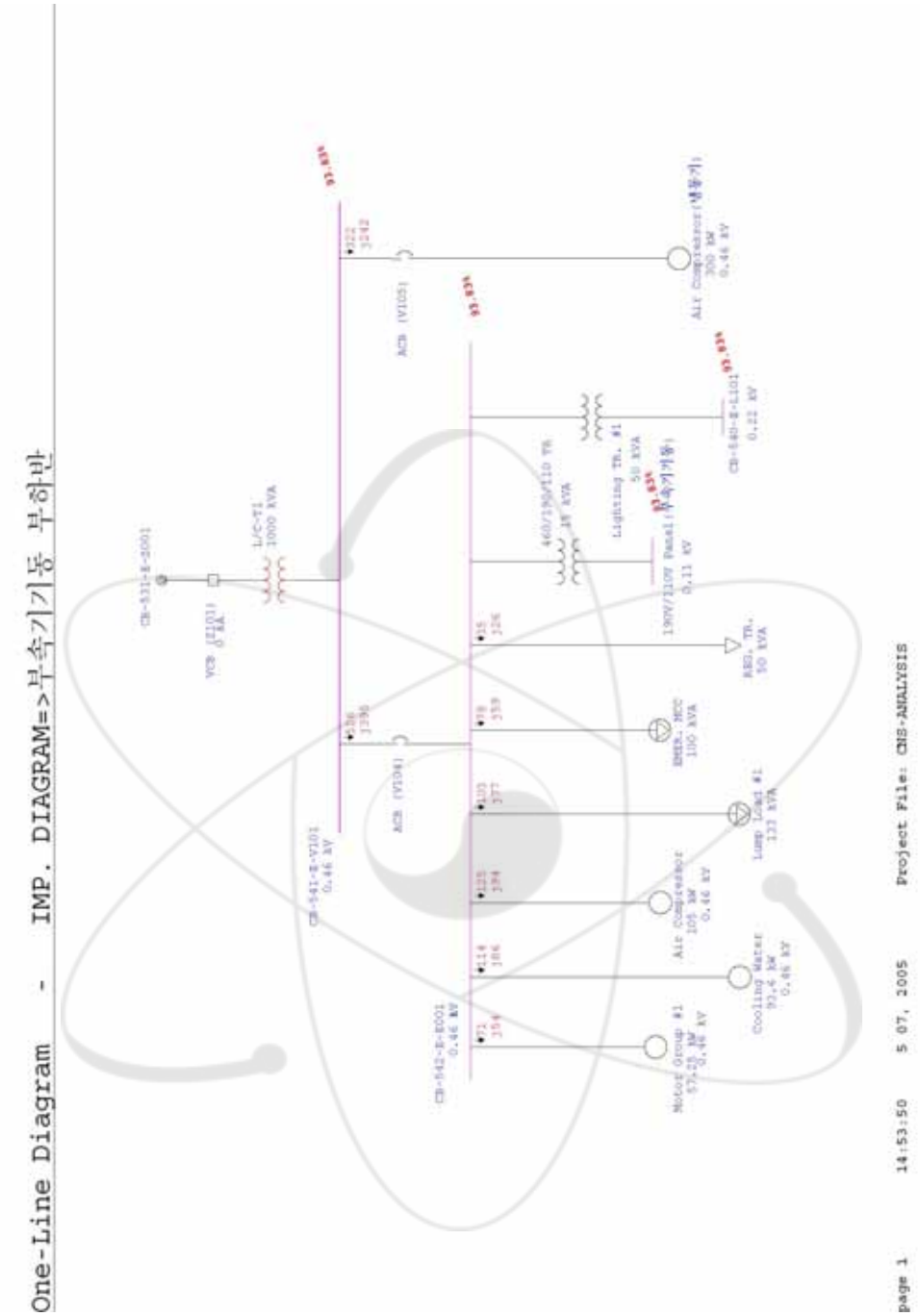

그림 2 전력조류분석 결과 (부속기기동 부하반)

그림 3 전력조류분석 결과 (실험동 부하반)

그림 4 전력조류분석 결과 (연구동 부하반)

제3절 모터기동분석

모터의 기동방식은 직입기동방식을 택하고 있으며 일반적으로 모터기동 시에는 정격전류의 약 5~10배의 기동전류가 흐른다. 이러한 기동전류에 의한 전압강하로 인하여 모선의 전압강하는 정격운전 시보다 크게 된다. 모터의 토크는 전압의 제곱에 비례하므로 만일 200%의 정동토크(breakdown torque)를 가진 모터가 전부하 운전할 때 전압이 70%로 떨어지면 49%의 토크가 발생되어 운전 중인 모터는 정지하게 된다. 모터를 과열로부터 보호하기 위하여 제한 시간 이내에 정격운전으로 들어가야 하며, 제한된 시간 이내에 기동을 위한 최소한의 기동 토크는 100%이므로 모터 기동 시의 단자전압은 모터 정격의 80% 이상이어야 한다. 또한 전압강하는 깜박임 현상 및 모터 제어의 기능을 약화시키므로 모터 기동을 제외한 정상상태에서 90% 이상이어야 한다.

모터기동분석은 모터 기동 시 전력조류 및 전압강하를 분석함으로써 전압강하에 의한 모터의 기동실패 또는 운전정지를 예측하고, 기동 시 다른 중요 부하에 미치는 영향을 분석하기 위한 것이다. 따라서 모터기동분석을 통해서 기동방식을 결정하거나 최적모터의 선정 및 다른 계통에 미치는 영향을 최소화 할 수 있다. 본 보고서에서는 CNS의 최대용량 모터(냉동기용 공기압축기용 모터)를 제외한 전 부하 운전 중 최대 용량 모터를 기동시켜 각 모선 및 모터 단자전압 강하를 확인하여 모터 기동 시 단자전압이 정격의 80%이상을 유지하는지 분석하였다.

1. 가정(Condition of Calculation and Assumption) 및 기준
   1) CNS 최대용량(300kW) 전동기인 냉동기용 air compressor 모터를 제외한 모든 부하는 정상 운전 중이라 가정한다. 표5는 모터기동분석을 위한 부하요약이다.
   2) CNS 전력계통의 운전 부하는 100% 부하로 가정한다.
   3) 연구소 주변전소의 22.9/6.6kV 변압기의 % 임피던스는 7%로 가정하였다.
   4) 이와 같은 가정으로 계산하였을 때 다음의 기준을 만족하여야 한다.
      -. 대용량 모터 기동 시 기기 또는 모선의 단자전압은 정격의 80% 이상유지
      -. 정상 운전 시 기기 또는 모선의 단자전압은 정격의 90% 이상유지
   5) 입력데이터는 전력조류분석과 동일하다.

2. 모터기동분석결과

표 6은 300kW 냉동기용 공기압축기 모터의 기동분석결과이다. 냉동기용 공기압축기를 제외한 CNS의 전부하가 정상운전일 때 각 모선 및 전동기 단자전압은 ETAP을 이용한 시뮬레이션 결과 정격의 90%이상을 유지하고 있다.

표 6에 공기압축기 모터 기동 전 안정 상태(@Ts=0.00-), 기동 시 과도상태(@Ts=1.00+), 기동 후 안정 상태(@Ts=5.00+)에서 각 모선의 전압을 나타내었다. ETAP 시뮬레이션 결과 대용량 모터 기동 직후 전압강하가 가장 큰 모선은 부속기기동 부하반(CB-541-E-V101) 및 전동기 제어반으로 정격전압의 82.27%까지 강하함을 보였다. 그러나 기동 후 안정 상태에서는 전압이 정격의 93.79%까지 회복됨으로써 모터 기동 시 정격의 80% 이상, 정상 상태에서 정격의 90% 이상인 기준을 만족함을 확인하였다. 모터기동분석 결과는 Appendix 2(page 10~15)에 자세히 나타나 있다.

스위치기어 및 각 부하반에서의 모터기동분석 결과 단선도는 그림 5, 6, 7, 8에 나타나있다.

표 5 모터기동분석 부하요약

구분	최대 수요 부하				비고
	Description	부하용량 (kVA)	부하종류	운전상태	
CB-541-E-V101 (Load Center)	Motor Loads	374	Motor	Running	Lump Sum
	Air Compressor	375	Motor	Starting	기동부하
	Static Loads	97	Static	Running	Lump Sum
	소 계	**846**			
KM-541-E-V201 (Load Center)	Motor Loads	318	Motor	Running	Lump Sum
	Static Loads	282	Static	Running	Lump Sum
	소 계	**600**			
KM-541-E-V301 (Load Center)	Motor Loads	306	Motor	Running	Lump Sum
	Static Loads	46	Static	Running	Lump Sum
	소 계	**352**			

표 6 모터기동분석의 전력조류분석 결과요약(전압강하)

BUS		air compressor 기동 전 % 전압 @Ts=0.00-	air compressor 기동 시 % 전압 @Ts=0.00+	air compressor 기동 후 % 전압 @Ts=5.00+	비고
BUS ID	정격 전압				
CB-531-E-Z001	6.6kV	98.94	96.99	98.62	스위치기어
CB-541-E-V101	0.46kV	96.01	82.27	93.79	부하반
CB-541-E-V201	0.46kV	97.16	95.19	96.84	부하반
CB-541-E-V301	0.46kV	97.11	95.13	96.79	부하반
CB-542-E-E001	0.46kV	96.01	82.27	93.79	전동기제어반
CB-542-E-E002	0.46kV	97.16	95.19	96.84	전동기제어반
CB-542-E-E003	0.46kV	97.16	95.19	96.84	전동기제어반
CB-542-E-E004	0.46kV	97.11	95.13	96.79	전동기제어반
CB-542-E-E005	0.46kV	97.11	95.13	96.79	전동기제어반
CB-540-E-L101	0.22kV	96.01	82.27	93.79	조명 판넬
CB-540-E-L102	0.22kV	97.16	95.19	96.84	조명 판넬
CB-540-E-L103	0.22kV	97.11	95.13	96.79	조명 판넬

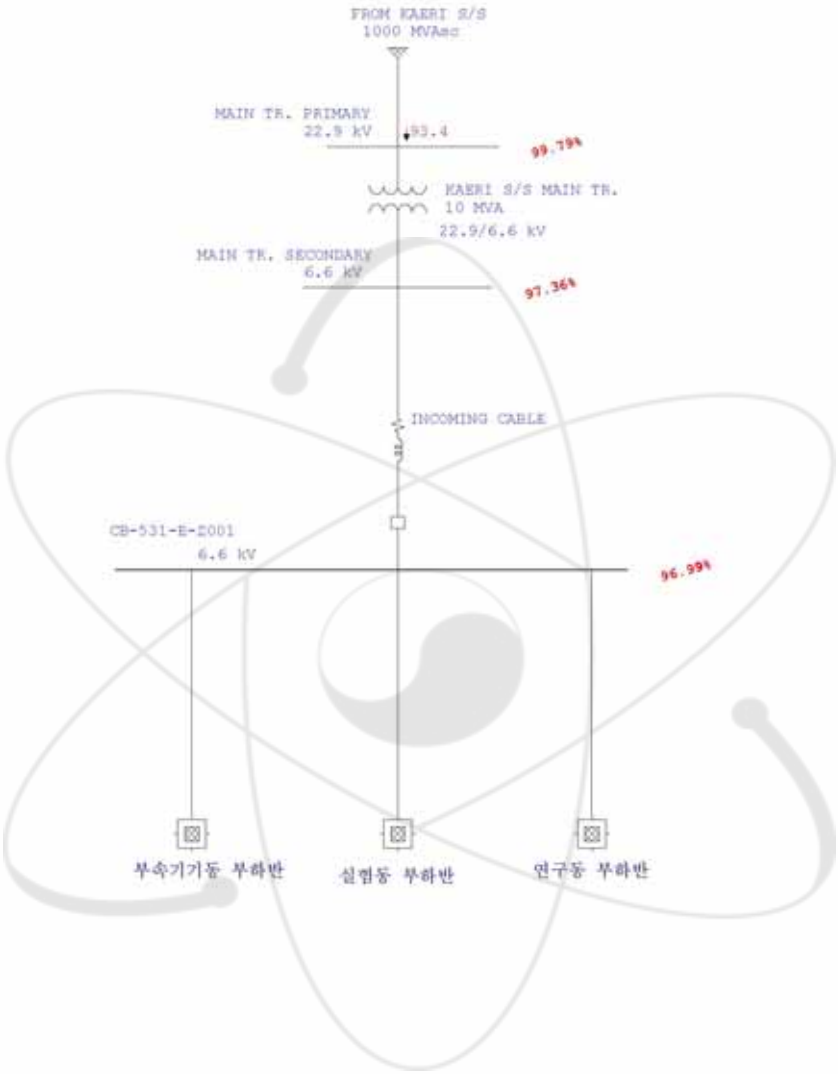

그림 5 모터기동분석 결과 (스위치기어)

그림 6 모터기동분석 결과 (부속기기동 부하반)

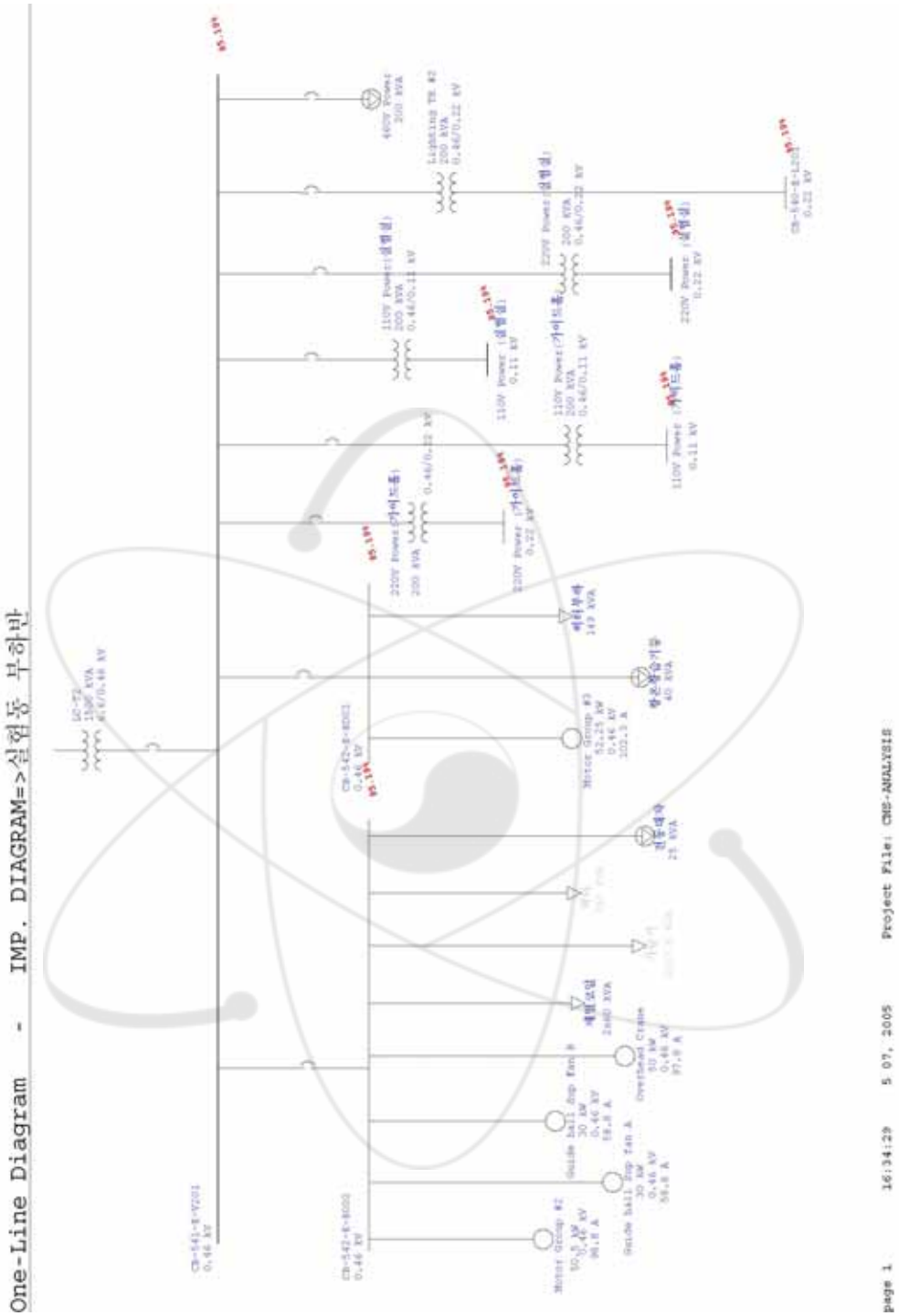

그림 7 모터기동분석 결과 (실험동 부하반)

그림 8 모터기동분석 결과 (연구동 부하반)

제4절 단락전류분석

단락전류분석은 사고발생 후 계통에 흐르는 예상 사고전류를 결정하기 위한 것이다. 일반적으로 계획단계에서는 기기의 배치, 계통전압의 결정, 변압기 및 케이블 용량 결정 등을 위해 수행되며, 운전 중인 계통에서는 모터부하의 증설, 계통의 변경, 보호협조의 재구성 및 차단기의 용량 검증에 사용된다.

단락전류의 크기 및 지속시간은 계통의 특성에 종속되며, 사고전류를 감지하고, 사고를 차단, 격리시키기 위한 보호시스템이 요구된다. CNS 전력계통의 보호설계를 위한 최대 단락용량을 결정하고 차단기, 스위치기어의 선정 및 보호계전기 설정을 위한 정보를 제공하기 위하여 ETAP을 이용하여 단락전류 분석을 하였다.

단락전류 분석에서는 ANSI C37에 따라 사고모선에서 momentary symmetrical and asymmetrical rms short circuit current, interrupting symmetrical rms short circuit current를 계산하였다.

1. 가정(Condition of Calculation and Assumption) 및 기준
   1) 모든 예비부하는 3상 단락전류 계산에서 제외한다.
   2) 계통에 포함된 모든 회전기기는 3상 단락전류 계산에 포함한다.
   3) 인입 케이블을 제외한 모든 케이블 및 모선의 임피던스는 무시한다.
   4) CNS의 인입 변전소인 KAERI S/S의 주변압기(22.9kV/6.6kV)의 1차측은 무한모선(Swing)으로 가정한다.
   5) 회전기의 초기과도 리액턴스는 X_d"는 IEEE Std. 141에 따른다.
   6) 회전기 X/R 비는 ANSI C37.010에 따른다.
   7) 변압기의 X/R 비는 IEEE Std. 141에 따른다.
   8) 모든 계산은 100MVA 기준으로 한다.

2. 단락전류 분석결과

CNS 인입 KAERI S/S의 주변압기 1차 측을 무한모선으로 가정하고 주변압기는 22.9kV/6.6kV, 10MVA, %Z는 5.5%, 허용오차는 7.5%이므로 2차 측 단락용량은 10MVA÷(0.055×0.925)≒197MVA이다. ETAP을 이용한 단락전류 분석결과 스위치기어 및 부하반 모선에서 1/2 Cycle 사고전류는 표 7에 나타나 있다. 차단기의 선정은 표에 나타난 사고전류보다 큰 차단용량을 가진 차단기를 선정하여야 한다. 스위치기어 및 각 부하반에서의 단락전류분석 결과 단선도는 그림 9, 10, 11, 12에 나타나있다. 단락전류 계산에 대한 자세한 시뮬레이션 결과는 Appendix 3에 나타나있다.

표 7 단락전류분석 결과요약

BUS		사고전류(kA)	비고
BUS ID	정격 전압		
CB-531-E-Z001	6.6kV	11.06	Appendix 3, 16p
CB-541-E-V101	0.46kV	25.02	Appendix 3, 21p
CB-541-E-V201	0.46kV	30.07	Appendix 3, 22p
CB-541-E-V301	0.46kV	21.03	Appendix 3, 23p

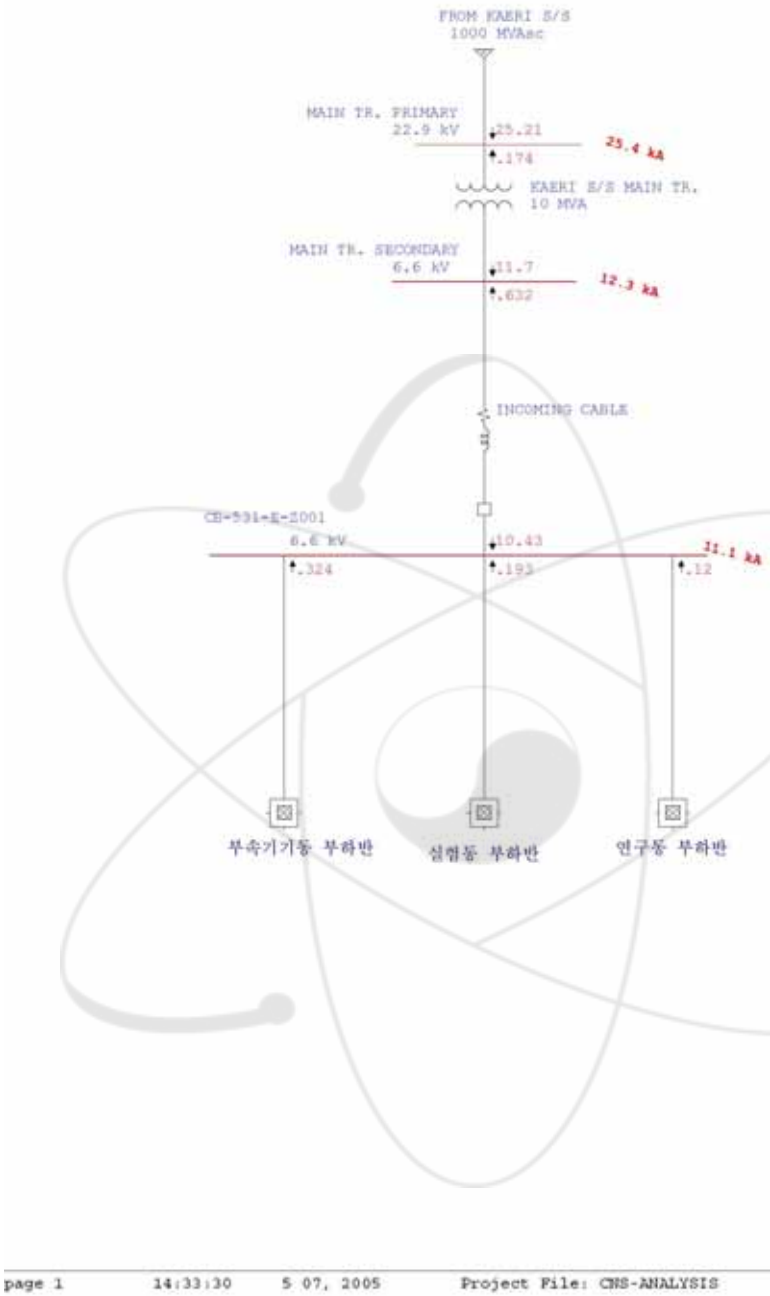

그림 9 단락전류분석 결과 (스위치기어)

그림 10 단락전류분석 결과 (부속기기동 부하반)

그림 11 단락전류분석 결과 (실험동 부하반)

그림 12 단락전류분석 결과 (연구동 부하반)

제3장 결론

1. CNS 전 부하가 정상운전중일 때 각 모선 및 모터의 단자 전압은 정격의 90% 이상을 만족한다.
2. 모터기동분석 결과 CNS의 최대용량 전동기(냉동기용 공기압축기, 300kW)를 제외한 전 부하 정상운전 시 단자전압은 정격의 90%를 만족하고 있으며, 최대용량의 모터 기동 시 모선 및 모터 단자전압은 정격의 80%를 만족하고 있으며 1초 이내에 정상상태로 회복된다.
3. 연구소 주변전소는 CNS에 2.369MVA(유효전력 1.953MW, 무효전력 1.341Mvar)을 공급하고 있으며 있다. 각 부하반 변압기에서의 손실은 부속기기동 73.47kVA, 실험동 30kVA, 연구동 11.26kVA이다.
4. 스위치 기어의 VCB 및 부하반의 차단기는 다음의 사고전류 이상의 차단용량을 필요로 한다.

BUS		사고전류(kA)
BUS ID	정격 전압	
CB-531-E-Z001	6.6kV	11.06
CB-541-E-V101	0.46kV	25.02
CB-541-E-V201	0.46kV	30.07
CB-541-E-V301	0.46kV	21.03

제4장 참고문헌

[1] “Recommended Practice for Industrial and Commercial Power System Analysis”, IEEE STD 399-1997.

[2] “CNS Single Line Diagram”, HAN-CS-DW-EI-500-05-001, KAERI, 2004

[3] ETAP Power Station User’s Manual (Ver.5.0.0)

APPENDIX 1. LOAD FLOW STUDY COMPUTER OUTPUT

CNS 전부하 정상 상태에서의 전력조류 분석

Electrical Transient Analyzer Program

Load Flow Analysis

Loading Category (1): Design

Generation Category (1): Design

Load Diversity Factor: None

	Swing	V-Control	Load	Total
Number of Buses:	1	0	19	20

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches:	13	0	0	1	0	5	19

Method of Solution: Newton-Raphson Method

Maximum No. of Iteration: 2000

Precision of Solution: 0.000100

System Frequency: 60 Hz

Unit System: English

Project Filename: CNS-ANALYSIS

Output Filename: D:₩User₩ETAP Simulation₩ETAP-CNS₩CNS-KIM₩Power-Flow-base.lfr

CNS 전부하 정상 상태에서의 전력조류 분석

[redacted]

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		

Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

CNS 전부하 정상 상태에서의 전력조류 분석

Bus Input Data

Bus			Initial Voltage		Load							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
110V Power (가이드홀)	0.110	1	96.9	-2.4								
110V Power (실험실)	0.110	1	96.9	-2.4								
190/110 Panel(연구동)	0.110	1	96.8	-1.9								
190V/110V Panel(부속기기동)	0.110	1	93.8	-3.5								
220V Power (가이드홀)	0.220	1	96.9	-2.4								
220V Power (실험실)	0.220	1	96.9	-2.4								
CB-531-E-Z001	6.600	1	98.7	-0.9								
CB-540-E-L101	0.220	1	93.8	-3.5								
CB-540-E-L201	0.220	1	96.9	-2.4								
CB-540-E-L301	0.220	1	96.8	-1.9								
CB-541-E-V101	0.460	1	93.8	-3.5	0.322	0.242						
CB-541-E-V201	0.460	1	96.9	-2.4	0.136	0.084	0.034	0.021				
CB-541-E-V301	0.460	1	96.8	-1.9								
CB-542-E-E001	0.460	1	93.8	-3.5	0.449	0.337	0.088	0.066				
CB-542-E-E002	0.460	1	96.9	-2.4	0.216	0.162	0.124	0.003				
CB-542-E-E003	0.460	1	96.9	-2.4	0.081	0.061	0.165	0.012				
CB-542-E-E004	0.460	1	96.8	-1.9	0.187	0.140						
CB-542-E-E005	0.460	1	96.8	-1.9	0.124	0.093	0.039	0.019				
MAIN TR. PRIMARY	22.900	1	100.0	0.0								
MAIN TR. SECONDARY	6.600	1	98.9	-0.8								
Total Number of Buses: 20					1.515	1.118	0.450	0.121	0.000	0.000	0.000	0.000

Generation Bus				Voltage		Generation			Mvar Limits	
ID	kV	Type	Sub-sys	% Mag.	Angle	MW	Mvar	% PF	Max	Min
MAIN TR. PRIMARY	22.900	Swing	1	100.0	0.0					
						0.000	0.000			

CNS 전부하 정상 상태에서의 전력조류 분석

Line/Cable Input Data

Ohms or Siemens/1000 ft per Conductor (Cable) or per Phase (Line)

Line/Cable ID	Library	Size	Length Adj. (ft)	% Tol.	#/Phase	T (°C)	R	X	Y
INCOMING CABLE	11NCUN1	300	984.3	0.0	1	75	0.023257	0.038405	0.000040

Line / Cable resistances are listed at the specified temperatures.

CNS 전부하 정상 상태에서의 전력조류 분석

2-Winding Transformer Input Data

Transformer	Rating					2 Winding			% Tap Setting		Adjusted	Phase Shift	
ID	MVA	Prim. kV	Sec. kV	% Z	X/R	+ 5%	- 5%	% Tol.	Prim.	Sec.	% Z	Type	Angle
110V Power(가이드홀)	0.200	0.460	0.110	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
110V Power(실험실)	0.200	0.460	0.110	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
220V Power(가이드홀)	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
220V Power(실험실)	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
460/190/110 Panel	0.015	0.460	0.110	2.30	1.13	0	0	0	0	0	2.3000	Std Pos. Seq.	0.0
460/190/110 TR	0.015	0.460	0.110	7.75	2.47	0	0	0	0	0	7.7500	Std Pos. Seq.	0.0
KAERI S/S MAIN TR.	10.000	22.900	6.600	7.00	15.50	0	0	7.5	0	0	7.5250	Std Pos. Seq.	0.0
L/C-T1	1.000	6.600	0.460	5.75	5.79	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
LC-T2	1.500	6.600	0.460	5.75	7.10	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
LC-T3	1.000	6.600	0.460	5.75	5.79	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
Lighring TR #3	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
Lighting TR #2	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
Lighting TR. #1	0.050	0.460	0.220	7.75	2.47	0	0	0	0	0	7.7500	Std Pos. Seq.	0.0

CNS 전부하 정상 상태에서의 전력조류 분석

Branch Connections

Cable/Branch		Connected Bus ID		Impedance, Pos. Seq., 100 MVA Base			
ID	Type	From Bus	To Bus	R	X	Z	Y
110V Power(가이드홀)	2W XFMR	CB-541-E-V201	110V Power (가이드홀)	499.46	2347.45	2400.00	
110V Power(실험실)	2W XFMR	CB-541-E-V201	110V Power (실험실)	499.46	2347.45	2400.00	
220V Power(가이드홀)	2W XFMR	CB-541-E-V201	220V Power (가이드홀)	499.46	2347.45	2400.00	
220V Power(실험실)	2W XFMR	CB-541-E-V201	220V Power (실험실)	499.46	2347.45	2400.00	
460/190/110 Panel	2W XFMR	CB-542-E-E004	190/110 Panel(연구동)	10161.66	11482.67	15333.33	
460/190/110 TR	2W XFMR	CB-542-E-E001	190V/110V Panel(부속기기	19388.93	47890.64	51666.67	
KAERI S/S MAIN TR.	2W XFMR	MAIN TR. PRIMARY	MAIN TR. SECONDARY	4.84	75.09	75.25	
L/C-T1	2W XFMR	CB-531-E-Z001	CB-541-E-V101	97.86	566.61	575.00	
LC-T2	2W XFMR	CB-531-E-Z001	CB-541-E-V201	53.46	379.59	383.33	
LC-T3	2W XFMR	CB-531-E-Z001	CB-541-E-V301	97.86	566.61	575.00	
Lighring TR #3	2W XFMR	CB-541-E-V301	CB-540-E-L301	499.46	2347.45	2400.00	
Lighting TR #2	2W XFMR	CB-541-E-V201	CB-540-E-L201	499.46	2347.45	2400.00	
Lighting TR. #1	2W XFMR	CB-542-E-E001	CB-540-E-L101	5816.68	14367.19	15500.00	
INCOMING CABLE	Cable	MAIN TR. SECONDARY	CB-531-E-Z001	5.25	8.68	10.14	0.0017315
ACB (V104)	Tie Breakr	CB-541-E-V101	CB-542-E-E001				
ACB (V203)	Tie Breakr	CB-541-E-V201	CB-542-E-E002				
ACB (V204)	Tie Breakr	CB-541-E-V201	CB-542-E-E003				
ACB(V303)	Tie Breakr	CB-541-E-V301	CB-542-E-E004				
ACB(V304)	Tie Breakr	CB-541-E-V301	CB-542-E-E005				

CNS 전부하 정상 상태에서의 전력조류 분석

LOAD FLOW REPORT

Bus		Voltage		Generation		Load		Load Flow				
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF
110V Power (가이드홀)	0.110	96.874	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0
110V Power (실험실)	0.110	96.874	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0
190/110 Panel(연구동)	0.110	96.823	-1.9	0	0	0	0	CB-542-E-E004	0.000	0.000	0.0	0.0
190V/110V Panel(부속기기	0.110	93.826	-3.5	0	0	0	0	CB-542-E-E001	0.000	0.000	0.0	0.0
220V Power (가이드홀)	0.220	96.874	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0
220V Power (실험실)	0.220	96.874	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0
CB-531-E-Z001	6.600	98.654	-0.9	0	0	0	0	MAIN TR. SECONDARY	-1.950	-1.338	209.7	82.5
								CB-541-E-V101	0.861	0.709	98.9	77.2
								CB-541-E-V201	0.740	0.368	73.3	89.6
								CB-541-E-V301	0.349	0.261	38.7	80.1
CB-540-E-L101	0.220	93.826	-3.5	0	0	0	0	CB-542-E-E001	0.000	0.000	0.0	0.0
CB-540-E-L201	0.220	96.874	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0
CB-540-E-L301	0.220	96.823	-1.9	0	0	0	0	CB-541-E-V301	0.000	0.000	0.0	0.0
CB-541-E-V101	0.460	93.826	-3.5	0	0	0.322	0.242	CB-531-E-Z001	-0.848	-0.636	1418.7	80.0
								CB-542-E-E001	0.526	0.395	879.9	80.0
CB-541-E-V201	0.460	96.874	-2.4	0	0	0.168	0.104	110V Power (가이드홀)	0.000	0.000	0.0	0.0
								110V Power (실험실)	0.000	0.000	0.0	0.0
								220V Power (가이드홀)	0.000	0.000	0.0	0.0
								220V Power (실험실)	0.000	0.000	0.0	0.0
								CB-531-E-Z001	-0.737	-0.341	1051.8	90.7
								CB-540-E-L201	0.000	0.000	0.0	0.0
								CB-542-E-E002	0.333	0.165	481.1	89.6
								CB-542-E-E003	0.236	0.072	319.8	95.6
CB-541-E-V301	0.460	96.823	-1.9	0	0	0	0	CB-531-E-Z001	-0.347	-0.250	554.7	81.1
								CB-540-E-L301	0.000	0.000	0.0	0.0
								CB-542-E-E004	0.187	0.140	302.4	80.0
								CB-542-E-E005	0.161	0.110	252.4	82.4
CB-542-E-E001	0.460	93.826	-3.5	0	0	0.526	0.395	190V/110V Panel(부속기기	0.000	0.000	0.0	0.0
								CB-540-E-L101	0.000	0.000	0.0	0.0
								CB-541-E-V101	-0.526	-0.395	879.9	80.0
CB-542-E-E002	0.460	96.874	-2.4	0	0	0.333	0.165	CB-541-E-V201	-0.333	-0.165	481.1	89.6
CB-542-E-E003	0.460	96.874	-2.4	0	0	0.236	0.072	CB-541-E-V201	-0.236	-0.072	319.8	95.6
CB-542-E-E004	0.460	96.823	-1.9	0	0	0.187	0.140	190/110 Panel(연구동)	0.000	0.000	0.0	0.0
								CB-541-E-V301	-0.187	-0.140	302.4	80.0
CB-542-E-E005	0.460	96.823	-1.9	0	0	0.161	0.110	CB-541-E-V301	-0.161	-0.110	252.4	82.4
*MAIN TR. PRIMARY	22.900	100.000	0.0	1.956	1.384	0	0	MAIN TR. SECONDARY	1.956	1.384	60.4	81.6

Xfmr
% Tap

CNS 전부하 정상 상태에서의 전력조류 분석

Bus		Voltage		Generation		Load		Load Flow				
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
MAIN TR. SECONDARY	6.600	98.876	-0.8	0	0	0	0	CB-531-E-Z001	1.953	1.341	209.6	82.4	
								MAIN TR. PRIMARY	-1.953	-1.341	209.6	82.4	

* Indicates a voltage regulated bus (voltage controlled or swing type machine connecte
)
# Indicates a bus with a load mismatch of more than 0.1 MVA

CNS 전부하 정상 상태에서의 전력조류 분석

Bus Loading Summary Report

Bus			Directly Connected Load								Total Bus Load			
			Constant kVA		Constant Z		Constant I		Generic					
ID	kV	Rated Amp	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar	MVA	% PF	Amp	Percent Loading
110V Power (가이드홀)	0.110		0	0	0	0	0	0	0	0	0	4.3	0.0	
110V Power (실험실)	0.110		0	0	0	0	0	0	0	0	0	4.3	0.0	
190/110 Panel(연구동)	0.110		0	0	0	0	0	0	0	0	0	100.0	0.0	
190V/110V Panel(부속기기	0.110		0	0	0	0	0	0	0	0	0	0.0	0.0	
220V Power (가이드홀)	0.220		0	0	0	0	0	0	0	0	0	4.3	0.0	
220V Power (실험실)	0.220		0	0	0	0	0	0	0	0	0	4.3	0.0	
CB-531-E-Z001	6.600		0	0	0	0	0	0	0	0	2.365	82.5	209.7	
CB-540-E-L101	0.220		0	0	0	0	0	0	0	0	0	0.0	0.0	
CB-540-E-L201	0.220		0	0	0	0	0	0	0	0	0	4.3	0.0	
CB-540-E-L301	0.220		0	0	0	0	0	0	0	0	0	62.6	0.0	
CB-541-E-V101	0.460		0.322	0.242	0	0	0	0	0	0	1.061	80.0	1418.7	
CB-541-E-V201	0.460		0.136	0.084	0.032	0.020	0	0	0	0	0.812	90.7	1051.8	
CB-541-E-V301	0.460		0	0	0	0	0	0	0	0	0.428	81.1	554.7	
CB-542-E-E001	0.460		0.449	0.337	0.077	0.058	0	0	0	0	0.658	80.0	879.9	
CB-542-E-E002	0.460		0.216	0.162	0.116	0.003	0	0	0	0	0.371	89.6	481.1	
CB-542-E-E003	0.460		0.081	0.061	0.155	0.011	0	0	0	0	0.247	95.6	319.8	
CB-542-E-E004	0.460		0.187	0.140	0	0	0	0	0	0	0.233	80.0	302.4	
CB-542-E-E005	0.460		0.124	0.093	0.037	0.018	0	0	0	0	0.195	82.4	252.4	
MAIN TR. PRIMARY	22.900		0	0	0	0	0	0	0	0	2.396	81.6	60.4	
MAIN TR. SECONDARY	6.600		0	0	0	0	0	0	0	0	2.369	82.4	209.6	

* Indicates operating load of a bus exceeds the bus critical limit (% of the Continuous Ampere rating).

# Indicates operating load of a bus exceeds the bus marginal limit (% of the Continuous Ampere rating).

CNS 전부하 정상 상태에서의 전력조류 분석

Branch Loading Summary Report

CKT / Branch		Cable & Reactor			Transformer				
		Ampacity	Loading		Capability	Loading (input)		Loading (output)	
ID	Type	(Amp)	Amp	%	(MVA)	MVA	%	MVA	%
110V Power(가이드홀)	Transformer				0.200				
110V Power(실험실)	Transformer				0.200				
220V Power(가이드홀)	Transformer				0.200				
220V Power(실험실)	Transformer				0.200				
460/190/110 Panel	Transformer				0.015				
460/190/110 TR	Transformer				0.015				
KAERI S/S MAIN TR.	Transformer				10.000	2.396	24.0	2.369	23.7
*L/C-T1	Transformer				1.000	1.115	111.5	1.061	106.1
LC-T2	Transformer				2.000	0.827	41.3	0.812	40.6
LC-T3	Transformer				1.000	0.436	43.6	0.428	42.8
Lighring TR #3	Transformer				0.200				
Lighting TR #2	Transformer				0.200				
Lighting TR. #1	Transformer				0.050				

* Indicates a branch with operating load exceeding the branch capability.

CNS 전부하 정상 상태에서의 전력조류 분석

Branch Losses Summary Report

CKT / Branch	From-To Bus Flow		To-From Bus Flow		Losses		% Bus Voltage		% Vd Drop
ID	MW	Mvar	MW	Mvar	kW	kvar	From	To	in Vmag
110V Power(가이드홀)							96.9	96.9	0.00
110V Power(실험실)							96.9	96.9	0.00
460/190/110 Panel							96.8	96.8	0.00
460/190/110 TR							93.8	93.8	0.00
220V Power(가이드홀)							96.9	96.9	0.00
220V Power(실험실)							96.9	96.9	0.00
INCOMING CABLE	-1.950	-1.338	1.953	1.341	3.0	3.3	98.7	98.9	0.22
L/C-T1	0.861	0.709	-0.848	-0.636	12.5	72.4	98.7	93.8	4.83
LC-T2	0.740	0.368	-0.737	-0.341	3.8	26.7	98.7	96.9	1.78
LC-T3	0.349	0.261	-0.347	-0.250	1.9	11.1	98.7	96.8	1.83
Lighting TR. #1							93.8	93.8	0.00
Lighting TR #2							96.9	96.9	0.00
Lighring TR #3							96.8	96.8	0.00
KAERI S/S MAIN TR.	1.956	1.384	-1.953	-1.341	2.8	43.1	100.0	98.9	1.12
					24.0	156.5			

CNS 전부하 정상 상태에서의 전력조류 분석

Alert Summary Report

% Alert Settings

	Critical	Marginal
Loading		
Bus	100.0	90.0
Cable	100.0	90.0
Reactor	100.0	90.0
Line	100.0	95.0
Transformer	100.0	90.0
Panel	100.0	95.0
Protective Device	100.0	90.0
Generator	100.0	90.0
Bus Voltage		
OverVoltage	105.0	102.0
UnderVoltage	93.0	95.0
Generator Excitation		
OverExcited (Q Max.	0.0	0.0
UnderExcited (Q Min	100.0	

Critical Report

ID	Rating	Unit	Calculated	% Value	Condition
L/C-T1	Transformer 1.000	MVA	1.061	106.1	OverLoad

Marginal Report

ID	Rating	Unit	Calculated	% Value	Condition
190V/110V Panel(부속기기동)	Bus 0.110	kV	0.103	93.8	UnderVoltage
CB-540-E-L101	Bus 0.220	kV	0.206	93.8	UnderVoltage
CB-541-E-V101	Bus 0.460	kV	0.432	93.8	UnderVoltage
CB-542-E-E001	Bus 0.460	kV	0.432	93.8	UnderVoltage

CNS 전부하 정상 상태에서의 전력조류 분석

System Summary of Total Generation, Loading & Demand

	MW	Mvar	MVA	%PF
Source (Swing Buses):	1.956	1.384	2.396	81.63Lagging
Source (Non-Swing Buses):	0.000	0.000	0.000	100.00Lagging
Total Demand:	1.956	1.384	2.396	81.63Lagging
Total Motor Load:	1.515	1.118	1.883	80.45Lagging
Total Static Load:	0.418	0.109		
Apparent Losses:	0.024	0.157		
System Mismatch:	0.000	0.000		

Number of Iterations: 1

APPENDIX 2. MOTOR STARTING STUDY COMPUTER OUTPUT

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

Motor Starting Analysis

Data

Prestart Loading Category (1): Design

Prestart Generation Category (1) : Design

Load Diversity Factor: None

	Swing	V-Control	Load	Total
Number of Buses:	1	0	19	20

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of	13	0	0	1	0	5	19

	Synchronou Genenerator	Power Grid	Synchronous Motor	Induction Machines	Total
Number of	0	1	0	1	2

Method of Solution: Newton-Raphson

Max. No. of Iterations: 99

Precision of Solution: 0.00010 MW and Mvar

System Frequency: 60 Hz

Unit System: English

Project Filename: CNS-ANALYSIS

Output Filename: D:₩User₩ETAP Simulation₩ETAP-CNS₩CNS-KIM₩MS-study.MS1

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

[redacted]

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		

Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

Bus Input Data

Bus			Initial Voltage		Load (MW, Mvar)							
					Constant kVA		Constant Z		Constant I		Generic	
ID	kV	Sub-sys	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	MW	Mvar
110V Power (가이드홀)	0.110	1	96.9	-2.4								
110V Power (실험실)	0.110	1	96.9	-2.4								
190/110 Panel(연구동)	0.110	1	96.8	-1.9								
190V/110V Panel(부속기기동)	0.110	1	93.8	-3.5								
220V Power (가이드홀)	0.220	1	96.9	-2.4								
220V Power (실험실)	0.220	1	96.9	-2.4								
CB-531-E-Z001	6.600	1	98.7	-0.9								
CB-540-E-L101	0.220	1	93.8	-3.5								
CB-540-E-L201	0.220	1	96.9	-2.4								
CB-540-E-L301	0.220	1	96.8	-1.9								
CB-541-E-V101	0.460	1	93.8	-3.5								
CB-541-E-V201	0.460	1	96.9	-2.4	0.136	0.084	0.034	0.021				
CB-541-E-V301	0.460	1	96.8	-1.9								
CB-542-E-E001	0.460	1	93.8	-3.5	0.449	0.337	0.088	0.066				
CB-542-E-E002	0.460	1	96.9	-2.4	0.216	0.162	0.124	0.003				
CB-542-E-E003	0.460	1	96.9	-2.4	0.081	0.061	0.165	0.012				
CB-542-E-E004	0.460	1	96.8	-1.9	0.187	0.140						
CB-542-E-E005	0.460	1	96.8	-1.9	0.124	0.093	0.039	0.019				
MAIN TR. PRIMARY	22.900	1	100.0	0.0								
MAIN TR. SECONDARY	6.600	1	98.9	-0.8								
Total Number of Buses: 20					1.192	0.877	0.450	0.121	0.000	0.000	0.000	0.000

Generation Bus				Voltage		Generation			Mvar Limits	
ID	kV	Type	Sub-sys	% Mag.	Angle	MW	Mvar	% PF	Max	Min
MAIN TR. PRIMARY	22.900	Swing	1	100.0	0.0					
						0.000	0.000			

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

Line/Cable Input Data

Ohms or Ohms/ 1000 ft per Conductor (Delta) or per Phase (Wye)

Line/Cable ID	Library	Size	Length Adj. (ft)	% Tol.	#/Phase	T (°C)	R	X	Y
INCOMING CABLE	11NCUN1	300	984.3	0.0	1	75	0.02326	0.03840	0.0000404

Line / Cable resistances are listed at the specified temperatures

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

2-Winding Transformer Input Data

Transformer	Rating					2 Winding			2 Tap Setting		Adjusted	Phase Shift	
ID	MVA	Prim. kV	Sec. kV	% Z	X/R	+ 5%	- 5%	% Tol.	Prim.	Sec.	% Z	Type	Angle
110V Power(가이드홀)	0.200	0.460	0.110	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
110V Power(실험실)	0.200	0.460	0.110	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
220V Power(가이드홀)	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
220V Power(실험실)	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
460/190/110 Panel	0.015	0.460	0.110	2.30	1.13	0	0	0	0	0	2.3000	Std Pos. Seq.	0.0
460/190/110 TR	0.015	0.460	0.110	7.75	2.47	0	0	0	0	0	7.7500	Std Pos. Seq.	0.0
KAERI S/S MAIN TR.	10.000	22.900	6.600	7.00	15.50	0	0	7.5	0	0	7.5250	Std Pos. Seq.	0.0
L/C-T1	1.000	6.600	0.460	5.75	5.79	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
LC-T2	1.500	6.600	0.460	5.75	7.10	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
LC-T3	1.000	6.600	0.460	5.75	5.79	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
Lighring TR #3	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
Lighting TR #2	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
Lighting TR. #1	0.050	0.460	0.220	7.75	2.47	0	0	0	0	0	7.7500	Std Pos. Seq.	0.0

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

Branch Connections

CKT Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA			
ID	Type	From Bus	To Bus	R	X	Z	Y
110V Power(가이드홀)	2W XFMR	CB-541-E-V201	110V Power (가이드홀)	499.46	2347.45	2400.00	
110V Power(실험실)	2W XFMR	CB-541-E-V201	110V Power (실험실)	499.46	2347.45	2400.00	
220V Power(가이드홀)	2W XFMR	CB-541-E-V201	220V Power (가이드홀)	499.46	2347.45	2400.00	
220V Power(실험실)	2W XFMR	CB-541-E-V201	220V Power (실험실)	499.46	2347.45	2400.00	
460/190/110 Panel	2W XFMR	CB-542-E-E004	190/110 Panel(연구동)	10161.66	11482.67	15333.33	
460/190/110 TR	2W XFMR	CB-542-E-E001	190V/110V Panel(부속기기	19388.93	47890.64	51666.67	
KAERI S/S MAIN TR.	2W XFMR	MAIN TR. PRIMARY	MAIN TR. SECONDARY	4.84	75.09	75.25	
L/C-T1	2W XFMR	CB-531-E-Z001	CB-541-E-V101	97.86	566.61	575.00	
LC-T2	2W XFMR	CB-531-E-Z001	CB-541-E-V201	53.46	379.59	383.33	
LC-T3	2W XFMR	CB-531-E-Z001	CB-541-E-V301	97.86	566.61	575.00	
Lighring TR #3	2W XFMR	CB-541-E-V301	CB-540-E-L301	499.46	2347.45	2400.00	
Lighting TR #2	2W XFMR	CB-541-E-V201	CB-540-E-L201	499.46	2347.45	2400.00	
Lighting TR. #1	2W XFMR	CB-542-E-E001	CB-540-E-L101	5816.68	14367.19	15500.00	
INCOMING CABLE	Cable	MAIN TR. SECONDARY	CB-531-E-Z001	5.25	8.68	10.14	0.0017315
ACB (V104)	Tie Breakr	CB-541-E-V101	CB-542-E-E001				
ACB (V203)	Tie Breakr	CB-541-E-V201	CB-542-E-E002				
ACB (V204)	Tie Breakr	CB-541-E-V201	CB-542-E-E003				
ACB(V303)	Tie Breakr	CB-541-E-V301	CB-542-E-E004				
ACB(V304)	Tie Breakr	CB-541-E-V301	CB-542-E-E005				

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

ID	Type	ID	MVA	kV	R	X"	X' *
FROM KAERI S/S	Utility	MAIN TR. PRIMARY	1000.000	22.900	9.95	99.50	99.50

Total Connected Machines (= 0): MVA

* Indicates the reactance used for machine represent

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

ID	Type	Qty	Connected Bus ID	HP/kW	kV	RPM	FLA	% PF	% Eff	% LRC	% PF	No Load	Full Load
Air Compressor(냉동기)	Ind.	1	CB-541-E-V101	300.0	0.460	1800	505.5	80.0	93.1	600.00	20.06	0.00	0.00

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

Sequence of Events

Time Event		Starting Load				% Loading		Load Change Time		Motor Load		Static Load	
Name	Time	ID	Type	Action	Category	Start	Final	Begin	End	MW	Mvar	MW	Mvar
start	0.000	Air Compressor(냉동기)	Ind. Motor	Start	Normal	100.0	100.0	0.00	0.00				

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

LOAD FLOW REPORT @ T=0.000

Bus				Generation		Load		Load Flow					
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
110V Power (가이드홀)	0.110	97.158	-2.3	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
110V Power (실험실)	0.110	97.158	-2.3	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
190/110 Panel(연구동)	0.110	97.109	-1.8	0	0	0	0	CB-542-E-E004	0.000	0.000	0.0	0.0	
190V/110V Panel(부속기기	0.110	96.012	-2.3	0	0	0	0	CB-542-E-E001	0.000	0.000	0.0	0.0	
220V Power (가이드홀)	0.220	97.158	-2.3	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
220V Power (실험실)	0.220	97.158	-2.3	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
CB-531-E-Z001	6.600	98.935	-0.7	0	0	0	0	MAIN TR. SECONDARY	-1.626	-1.054	171.3	83.9	
								CB-541-E-V101	0.535	0.424	60.3	78.3	
								CB-541-E-V201	0.742	0.368	73.2	89.6	
								CB-541-E-V301	0.349	0.261	38.6	80.1	
CB-540-E-L101	0.220	96.012	-2.3	0	0	0	0	CB-542-E-E001	0.000	0.000	0.0	0.0	
CB-540-E-L201	0.220	97.158	-2.3	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
CB-540-E-L301	0.220	97.109	-1.8	0	0	0	0	CB-541-E-V301	0.000	0.000	0.0	0.0	
CB-541-E-V101	0.460	96.012	-2.3	0	0	0	0	CB-531-E-Z001	-0.530	-0.397	865.8	80.0	
								CB-542-E-E001	0.530	0.397	865.8	80.0	
CB-541-E-V201	0.460	97.158	-2.3	0	0	0.168	0.104	110V Power (가이드홀)	0.000	0.000	0.0	0.0	
								110V Power (실험실)	0.000	0.000	0.0	0.0	
								220V Power (가이드홀)	0.000	0.000	0.0	0.0	
								220V Power (실험실)	0.000	0.000	0.0	0.0	
								CB-531-E-Z001	-0.738	-0.341	1050.9	90.8	
								CB-540-E-L201	0.000	0.000	0.0	0.0	
								CB-542-E-E002	0.333	0.165	480.5	89.6	
								CB-542-E-E003	0.237	0.072	320.0	95.7	
CB-541-E-V301	0.460	97.109	-1.8	0	0	0	0	CB-531-E-Z001	-0.347	-0.250	553.4	81.1	
								CB-540-E-L301	0.000	0.000	0.0	0.0	
								CB-542-E-E004	0.187	0.140	301.5	80.0	
								CB-542-E-E005	0.161	0.110	252.0	82.5	
CB-542-E-E001	0.460	96.012	-2.3	0	0	0.530	0.397	190V/110V Panel(부속기기	0.000	0.000	0.0	0.0	
								CB-540-E-L101	0.000	0.000	0.0	0.0	
								CB-541-E-V101	-0.530	-0.397	865.8	80.0	
CB-542-E-E002	0.460	97.158	-2.3	0	0	0.333	0.165	CB-541-E-V201	-0.333	-0.165	480.5	89.6	
CB-542-E-E003	0.460	97.158	-2.3	0	0	0.237	0.072	CB-541-E-V201	-0.237	-0.072	320.0	95.7	
CB-542-E-E004	0.460	97.109	-1.8	0	0	0.187	0.140	190/110 Panel(연구동)	0.000	0.000	0.0	0.0	
								CB-541-E-V301	-0.187	-0.140	301.5	80.0	
CB-542-E-E005	0.460	97.109	-1.8	0	0	0.161	0.110	CB-541-E-V301	-0.161	-0.110	252.0	82.5	
*MAIN TR. PRIMARY	22.900	100.000	0.0	0	0	0	0	MAIN TR. SECONDARY	1.630	1.084	49.4	83.3	
								FROM KAERI S/S	-1.630	-1.084	49.4	83.3	
MAIN TR. SECONDARY	6.600	99.114	-0.7	0	0	0	0	CB-531-E-Z001	1.628	1.055	171.2	83.9	
								MAIN TR. PRIMARY	-1.628	-1.055	171.2	83.9	
*FROM KAERI S/S	22.900	100.124	0.1	1.630	1.088	0	0	MAIN TR. PRIMARY	1.630	1.088	49.4	83.2	

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

* Indicates a voltage regulated bus (voltage controlled or swing type machine connecte
)

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

LOAD FLOW REPORT @ T=0.000s

Bus				Generation		Load		Load Flow					
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
110V Power (가이드홀)	0.110	95.186	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
110V Power (실험실)	0.110	95.186	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
190/110 Panel(연구동)	0.110	95.129	-1.9	0	0	0	0	CB-542-E-E004	0.000	0.000	0.0	0.0	
190V/110V Panel(부속기기	0.110	82.272	-2.8	0	0	0	0	CB-542-E-E001	0.000	0.000	0.0	0.0	
220V Power (가이드홀)	0.220	95.186	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
220V Power (실험실)	0.220	95.186	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
CB-531-E-Z001	6.600	96.988	-0.8	0	0	0	0	MAIN TR. SECONDARY	-1.981	-3.000	324.2	55.1	
								CB-541-E-V101	0.903	2.372	228.9	35.6	
								CB-541-E-V201	0.730	0.367	73.7	89.3	
								CB-541-E-V301	0.348	0.261	39.2	80.0	
CB-540-E-L101	0.220	82.272	-2.8	0	0	0	0	CB-542-E-E001	0.000	0.000	0.0	0.0	
CB-540-E-L201	0.220	95.186	-2.4	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
CB-540-E-L301	0.220	95.129	-1.9	0	0	0	0	CB-541-E-V301	0.000	0.000	0.0	0.0	
CB-541-E-V101	0.460	82.272	-2.8	0	0	0.328	1.602	CB-531-E-Z001	-0.836	-1.984	3284.2	38.9	
								CB-542-E-E001	0.508	0.381	969.4	80.0	
CB-541-E-V201	0.460	95.186	-2.4	0	0	0.167	0.103	110V Power (가이드홀)	0.000	0.000	0.0	0.0	
								110V Power (실험실)	0.000	0.000	0.0	0.0	
								220V Power (가이드홀)	0.000	0.000	0.0	0.0	
								220V Power (실험실)	0.000	0.000	0.0	0.0	
								CB-531-E-Z001	-0.726	-0.340	1057.3	90.6	
								CB-540-E-L201	0.000	0.000	0.0	0.0	
								CB-542-E-E002	0.329	0.165	484.8	89.4	
								CB-542-E-E003	0.231	0.072	318.6	95.5	
CB-541-E-V301	0.460	95.129	-1.9	0	0	0	0	CB-531-E-Z001	-0.346	-0.250	562.7	81.1	
								CB-540-E-L301	0.000	0.000	0.0	0.0	
								CB-542-E-E004	0.187	0.140	307.8	80.0	
								CB-542-E-E005	0.159	0.110	255.1	82.4	
CB-542-E-E001	0.460	82.272	-2.8	0	0	0.508	0.381	190V/110V Panel(부속기기	0.000	0.000	0.0	0.0	
								CB-540-E-L101	0.000	0.000	0.0	0.0	
								CB-541-E-V101	-0.508	-0.381	969.4	80.0	
CB-542-E-E002	0.460	95.186	-2.4	0	0	0.329	0.165	CB-541-E-V201	-0.329	-0.165	484.8	89.4	
CB-542-E-E003	0.460	95.186	-2.4	0	0	0.231	0.072	CB-541-E-V201	-0.231	-0.072	318.6	95.5	
CB-542-E-E004	0.460	95.129	-1.9	0	0	0.187	0.140	190/110 Panel(연구동)	0.000	0.000	0.0	0.0	
								CB-541-E-V301	-0.187	-0.140	307.8	80.0	
CB-542-E-E005	0.460	95.129	-1.9	0	0	0.159	0.110	CB-541-E-V301	-0.159	-0.110	255.1	82.4	
*MAIN TR. PRIMARY	22.900	99.794	0.0	0	0	0	0	MAIN TR. SECONDARY	1.995	3.113	93.4	54.0	
								FROM KAERI S/S	-1.995	-3.113	93.4	54.0	
MAIN TR. SECONDARY	6.600	97.364	-0.8	0	0	0	0	CB-531-E-Z001	1.988	3.010	324.1	55.1	
								MAIN TR. PRIMARY	-1.988	-3.010	324.1	55.1	
*FROM KAERI S/S	22.900	100.124	0.1	1.996	3.127	0	0	MAIN TR. PRIMARY	1.996	3.127	93.4	53.8	

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

* Indicates a voltage regulated bus (voltage controlled or swing type machine connecte
)

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

LOAD FLOW REPORT @ T=0.000s

Bus				Generation		Load		Load Flow					
ID	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	ID	MW	Mvar	Amp	% PF	% Tap
110V Power (가이드홀)	0.110	96.840	-2.5	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
110V Power (실험실)	0.110	96.840	-2.5	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
190/110 Panel(연구동)	0.110	96.789	-1.9	0	0	0	0	CB-542-E-E004	0.000	0.000	0.0	0.0	
190V/110V Panel(부속기기	0.110	93.791	-3.5	0	0	0	0	CB-542-E-E001	0.000	0.000	0.0	0.0	
220V Power (가이드홀)	0.220	96.840	-2.5	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
220V Power (실험실)	0.220	96.840	-2.5	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
CB-531-E-Z001	6.600	98.621	-0.9	0	0	0	0	MAIN TR. SECONDARY	-1.950	-1.338	209.8	82.5	
								CB-541-E-V101	0.861	0.709	98.9	77.2	
								CB-541-E-V201	0.740	0.368	73.3	89.5	
								CB-541-E-V301	0.349	0.261	38.7	80.1	
CB-540-E-L101	0.220	93.791	-3.5	0	0	0	0	CB-542-E-E001	0.000	0.000	0.0	0.0	
CB-540-E-L201	0.220	96.840	-2.5	0	0	0	0	CB-541-E-V201	0.000	0.000	0.0	0.0	
CB-540-E-L301	0.220	96.789	-1.9	0	0	0	0	CB-541-E-V301	0.000	0.000	0.0	0.0	
CB-541-E-V101	0.460	93.791	-3.5	0	0	0.322	0.242	CB-531-E-Z001	-0.848	-0.636	1419.1	80.0	
								CB-542-E-E001	0.526	0.395	880.1	80.0	
CB-541-E-V201	0.460	96.840	-2.5	0	0	0.168	0.104	110V Power (가이드홀)	0.000	0.000	0.0	0.0	
								110V Power (실험실)	0.000	0.000	0.0	0.0	
								220V Power (가이드홀)	0.000	0.000	0.0	0.0	
								220V Power (실험실)	0.000	0.000	0.0	0.0	
								CB-531-E-Z001	-0.736	-0.341	1051.9	90.7	
								CB-540-E-L201	0.000	0.000	0.0	0.0	
								CB-542-E-E002	0.333	0.165	481.2	89.6	
								CB-542-E-E003	0.236	0.072	319.8	95.6	
CB-541-E-V301	0.460	96.789	-1.9	0	0	0	0	CB-531-E-Z001	-0.347	-0.250	554.9	81.1	
								CB-540-E-L301	0.000	0.000	0.0	0.0	
								CB-542-E-E004	0.187	0.140	302.5	80.0	
								CB-542-E-E005	0.161	0.110	252.5	82.4	
CB-542-E-E001	0.460	93.791	-3.5	0	0	0.526	0.395	190V/110V Panel(부속기기	0.000	0.000	0.0	0.0	
								CB-540-E-L101	0.000	0.000	0.0	0.0	
								CB-541-E-V101	-0.526	-0.395	880.1	80.0	
CB-542-E-E002	0.460	96.840	-2.5	0	0	0.333	0.165	CB-541-E-V201	-0.333	-0.165	481.2	89.6	
CB-542-E-E003	0.460	96.840	-2.5	0	0	0.236	0.072	CB-541-E-V201	-0.236	-0.072	319.8	95.6	
CB-542-E-E004	0.460	96.789	-1.9	0	0	0.187	0.140	190/110 Panel(연구동)	0.000	0.000	0.0	0.0	
								CB-541-E-V301	-0.187	-0.140	302.5	80.0	
CB-542-E-E005	0.460	96.789	-1.9	0	0	0.161	0.110	CB-541-E-V301	-0.161	-0.110	252.5	82.4	
*MAIN TR. PRIMARY	22.900	99.967	0.0	0	0	0	0	MAIN TR. SECONDARY	1.956	1.384	60.4	81.6	
								FROM KAERI S/S	-1.956	-1.384	60.4	81.6	
MAIN TR. SECONDARY	6.600	98.842	-0.8	0	0	0	0	CB-531-E-Z001	1.953	1.341	209.7	82.4	
								MAIN TR. PRIMARY	-1.953	-1.341	209.7	82.4	
*FROM KAERI S/S	22.900	100.124	0.1	1.956	1.390	0	0	MAIN TR. PRIMARY	1.956	1.390	60.4	81.5	

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

* Indicates a voltage regulated bus (voltage controlled or swing type machine connecte
)

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

MOV Terminal Voltage	≤ 80.00	(Vmtr, rate)
Motor Terminal Voltage	≤ 80.00	(Vmtr, rate)
Failed to Start, Slip Kept	≥ 5.00	

Generator Rating	100.00	0.00
Engine Continuous Ratin	100.00	0.00
Engine Peak Rating	100.00	0.00
Exciter Peak Rating	100.00	0.00

Starting Motor Bus	VBus ≤ 80.00	0.00
Grid/Generator Bus	VBus ≤ 92.00	0.00
HV Bus, kV ≥ 10.00	VBus ≤ 90.00	0.00
MV Bus, 10.00 > kV > 1.00	VBus ≤ 90.00	0.00
LV Bus, kV ≤ 1.00	VBus ≤ 90.00	0.00

ID	Relay Type	Mea	Condition	Setting	Unit	Calculated	Pickup	Time	Duration
190V/110V Panel(부속기기동)	LV Bus	Bus Voltage	Under Voltage	0.110	kV	0.090	82.3	0.000	0.000
CB-540-E-L101	LV Bus	Bus Voltage	Under Voltage	0.220	kV	0.181	82.3	0.000	0.000
CB-541-E-V101	LV Bus	Bus Voltage	Under Voltage	0.460	kV	0.378	82.3	0.000	0.000
CB-542-E-E001	LV Bus	Bus Voltage	Under Voltage	0.460	kV	0.378	82.3	0.000	0.000

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

[illegible]

[illegible]

Time (sec.)	Current (% FLA)	% Terminal Voltage ~~kVb Load~~	~~kVb Bus~~	% Bus Voltage	kW	kvar
[illegible]	493.63	82.27	82.27	82.27	328.10	1602.42
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65

Time (sec.)	Current (% FLA)	% Terminal Voltage ~~kVb Load~~	~~kVb Bus~~	% Bus Voltage	kW	kvar
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

[illegible]

[illegible]	Current (% FLA)	% Terminal Voltage kVb Load	kVb Bus	% Bus Voltage	kW	kvar	[illegible]	Current (% FLA)	% Terminal Voltage kVb Load	kVb Bus	% Bus Voltage	kW	kvar
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65	[illegible]	106.62	93.79	93.79	93.79	322.20	241.65
[illegible]	106.62	93.79	93.79	93.79	322.20	241.65							

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

[redacted]

[redacted]	Current (% FLA)	% Terminal Voltage kVb Load	kVb Bus	% Bus Voltage	kW	kvar	[redacted]	Current (% FLA)	% Terminal Voltage kVb Load	kVb Bus	% Bus Voltage	kW	kvar
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65	[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65							

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

[illegible] [illegible]

[illegible]	Current (% FLA)	% Terminal Voltage kVb Load	kVb Bus	% Bus Voltage	kW	kvar
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65

[illegible]	Current (% FLA)	% Terminal Voltage kVb Load	kVb Bus	% Bus Voltage	kW	kvar
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65
[redacted]	106.62	93.79	93.79	93.79	322.20	241.65

[illegible]

[illegible] [illegible]

[illegible]	Current (% FLA)	% Terminal Voltage	MW	Mvar	MVA	% PF
[redacted]	3.71	99.79	1.995	3.113	3.697	53.96
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62

[illegible]	Current (% FLA)	% Terminal Voltage	MW	Mvar	MVA	% PF
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62
[redacted]	2.40	99.97	1.956	1.384	2.396	81.62

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

[illegible]

[illegible]	Current (% FLA)	% Terminal Voltage	MW	Mvar	MVA	% PF
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62

[illegible]	Current (% FLA)	% Terminal Voltage	MW	Mvar	MVA	% PF
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

[illegible]

[illegible]	Current (% FLA)	% Terminal Voltage	MW	Mvar	MVA	% PF
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62

[illegible]	Current (% FLA)	% Terminal Voltage	MW	Mvar	MVA	% PF
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62

모든 CNS 설비가 운전 중인 상태에서 부하가 가장 큰 Compressor(300kW)를 투입

[illegible]

[illegible]	Current (% FLA)	% Terminal Voltage	MW	Mvar	MVA	% PF
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62

[illegible]	Current (% FLA)	% Terminal Voltage	MW	Mvar	MVA	% PF
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62
[illegible]	2.40	99.97	1.956	1.384	2.396	81.62

Note: The power grid FLA is calculated based on the rated kV and 100 MVA base

APPENDIX 3. SHORT-CIRCUIT CURRENT STUDY COMPUTER OUTPUT

Electrical Transient Analyzer Program

Short-Circuit Analysis

ANSI Standard
3-Phase Fault Currents

	Swing	V-Control	Load	Total
Number of Buses:	1	0	19	20

	XFMR2	XFMR3	Reactor	Line/Cable	Impedance	Tie PD	Total
Number of Branches	13	0	0	1	0	5	19

	Synchronou Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Total
Number of Machine	0	1	0	13	6	20

System Frequency: 60 Hz

Unit System: English

Project Filename: CNS-ANALYSIS

Output Filename: D:₩User₩ETAP Simulation₩ETAP-CNS₩CNS-KIM₩SCstudy-base.SA1

Adjustments

Tolerance	Apply Adjustments	Individual /Global	Percent
Transformer Impedance:	Yes	Individual	
Reactor Impedance:	Yes	Individual	
Overload Heater Resistance:	No		
Transmission Line Length:	No		
Cable Length:	No		

Temperature Correction	Apply Adjustments	Individual /Global	Degree C
Transmission Line Resistance:	Yes	Individual	
Cable Resistance:	Yes	Individual	

Bus Input Data

ID	Type	Nom. kV	Base kV	Sub-sys	%Mag.	Ang.
110V Power (가이드홀)	Load	0.110	0.110	1	100.00	0.00
110V Power (실험실)	Load	0.110	0.110	1	100.00	0.00
190/110 Panel(연구동)	Load	0.110	0.110	1	100.00	0.00
190V/110V Panel(부속기기동)	Load	0.110	0.110	1	94.58	-2.90
220V Power (가이드홀)	Load	0.220	0.220	1	100.00	0.00
220V Power (실험실)	Load	0.220	0.220	1	100.00	0.00
CB-531-E-Z001	Load	6.600	6.600	1	99.39	-0.30
CB-540-E-L101	Load	0.220	0.220	1	100.00	0.00
CB-540-E-L201	Load	0.220	0.220	1	100.00	0.00
CB-540-E-L301	Load	0.220	0.220	1	100.00	0.00
CB-541-E-V101	Load	0.460	0.460	1	100.00	0.00
CB-541-E-V201	Load	0.460	0.460	1	100.00	0.00
CB-541-E-V301	Load	0.460	0.460	1	100.00	0.00
CB-542-E-E001	Load	0.460	0.460	1	100.00	0.00
CB-542-E-E002	Load	0.460	0.460	1	100.00	0.00
CB-542-E-E003	Load	0.460	0.460	1	100.00	0.00
CB-542-E-E005	Load	0.460	0.460	1	100.00	0.00
CB-542-E-E304	Load	0.460	0.460	1	100.00	0.00
MAIN TR. PRIMARY	SWNG	22.900	22.900	1	100.00	0.00
MAIN TR. SECONDARY	Load	6.600	6.600	1	100.00	0.00

20 Buses Total

All voltages reported by PowerStation are in % of bus Nominal kV.
Base kV values of buses are calculated and used internally by PowerStation.

[redacted]

[redacted]

[redacted]

ID	Library	Size	Length Adj. (ft)	% Tol.	#/Phase	T (°C)	R	X	Y
INCOMING CABLE	11NCUN1	300	984.3	0	1	75	0.02326	0.03840	0.0000404

Line / Cable resistances are listed at the specified temperatures.

2-Winding Transformer Input Data

Transformer	Rating					2% Tolerance			2% Tap Setting Adjusted			Phase Shift	
ID	MVA	Prim. kV	Sec. kV	% Z	X/R	+ 5%	- 5%	% Tol.	Prim.	Sec.	% Z	Type	Angle
110V Power(가이드홀)	0.200	0.460	0.110	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
110V Power(실험실)	0.200	0.460	0.110	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
220V Power(가이드홀)	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
220V Power(실험실)	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
460/190/110 Panel	0.015	0.460	0.110	2.30	1.13	0	0	0	0	0	2.3000	Std Pos. Seq.	0.0
460/190/110 TR	0.015	0.460	0.110	7.75	2.47	0	0	0	0	0	7.7500	Std Pos. Seq.	0.0
KAERI S/S MAIN TR.	10.000	22.900	6.600	7.00	15.50	0	0	-7.5	0	0	6.4750	Std Pos. Seq.	0.0
L/C-T1	1.000	6.600	0.460	5.75	5.79	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
LC-T2	1.500	6.600	0.460	5.75	7.10	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
LC-T3	1.000	6.600	0.460	5.75	5.79	0	0	0	0	0	5.7500	Std Pos. Seq.	0.0
Lighring TR #3	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
Lighting TR #2	0.200	0.460	0.220	4.80	4.70	0	0	0	0	0	4.8000	Std Pos. Seq.	0.0
Lighting TR. #1	0.050	0.460	0.220	7.75	2.47	0	0	0	0	0	7.7500	Std Pos. Seq.	0.0

Branch Connections

Branch		Connected Bus ID		% Impedance, Pos. Seq., 100 MVA			
ID	Type	From Bus	To Bus	R	X	Z	Y
110V Power(가이드홀)	2W XFMR	CB-541-E-V201	110V Power (가이드홀)	499.46	2347.45	2400.00	
110V Power(실험실)	2W XFMR	CB-541-E-V201	110V Power (실험실)	499.46	2347.45	2400.00	
220V Power(가이드홀)	2W XFMR	CB-541-E-V201	220V Power (가이드홀)	499.46	2347.45	2400.00	
220V Power(실험실)	2W XFMR	CB-541-E-V201	220V Power (실험실)	499.46	2347.45	2400.00	
460/190/110 Panel	2W XFMR	CB-542-E-E304	190/110 Panel(연구동)	10161.66	11482.67	15333.33	
460/190/110 TR	2W XFMR	CB-542-E-E001	190V/110V Panel(부속기기	19388.93	47890.64	51666.67	
KAERI S/S MAIN TR.	2W XFMR	MAIN TR. PRIMARY	MAIN TR. SECONDARY	4.17	64.62	64.75	
L/C-T1	2W XFMR	CB-531-E-Z001	CB-541-E-V101	97.86	566.61	575.00	
LC-T2	2W XFMR	CB-531-E-Z001	CB-541-E-V201	53.46	379.59	383.33	
LC-T3	2W XFMR	CB-531-E-Z001	CB-541-E-V301	97.86	566.61	575.00	
Lighring TR #3	2W XFMR	CB-541-E-V301	CB-540-E-L301	499.46	2347.45	2400.00	
Lighting TR #2	2W XFMR	CB-541-E-V201	CB-540-E-L201	499.46	2347.45	2400.00	
Lighting TR. #1	2W XFMR	CB-542-E-E001	CB-540-E-L101	5816.68	14367.19	15500.00	
INCOMING CABLE	Cable	MAIN TR. SECONDARY	CB-531-E-Z001	5.25	8.68	10.14	
ACB (V104)	Tie Breaker	CB-541-E-V101	CB-542-E-E001				
ACB (V203)	Tie Breaker	CB-541-E-V201	CB-542-E-E002				
ACB (V204)	Tie Breaker	CB-541-E-V201	CB-542-E-E003				
ACB(V303)	Tie Breaker	CB-541-E-V301	CB-542-E-E304				
ACB(V304)	Tie Breaker	CB-541-E-V301	CB-542-E-E005				

Power Grid Input Data

Power Grid	Connected Bus	Rating		SC Impedance 100 MVA Base		
ID	ID	MVASC	kV	X/R	R	X
FROM KAERI S/S	MAIN TR. PRIMARY	1000.000	22.900	10.00	0.99504	9.95037

Total Connected Power Grids (= 1): 1000.000 MVA

Induction Machine Input Data

Induction Machine		Connected Bus	Rating				X/R Ratio		Impedance (Motor Base)		
ID	Qty	ID	HP/kW	kVA	kV	RPM	X"/R	X'/R	R	X"	X'
Air Compressor(냉동기)	1	CB-541-E-V101	300.00	403.00	0.460	1800	15.62	15.62	1.28	20.00	50.00
Motor Group #1	1	CB-542-E-E001	57.25	89.20	0.460	1800	6.82	6.82	2.93	20.00	50.00
Air Compressor	1	CB-542-E-E001	105.00	156.00	0.460	1800	9.24	9.24	2.16	20.00	50.00
Cooling Water	1	CB-542-E-E001	93.60	143.00	0.460	1800	8.73	8.73	2.29	20.00	50.00
Motor Group #2	1	CB-542-E-E002	50.50	78.70	0.460	1800	6.41	6.41	3.12	20.00	50.00
Guide hall Sup fan A	1	CB-542-E-E002	30.00	46.80	0.460	1800	4.94	4.94	5.63	27.83	9999.00
Guide hall Sup fan B	1	CB-542-E-E002	30.00	46.80	0.460	1800	4.94	4.94	5.63	27.83	9999.00
Overhead Crane	1	CB-542-E-E002	50.00	78.00	0.460	1800	6.38	6.38	3.14	20.00	50.00
Motor Group #3	1	CB-542-E-E003	52.25	81.50	0.460	1800	6.52	6.52	3.07	20.00	50.00
Motor Group #5	1	CB-542-E-E005	18.40	29.60	0.460	1800	3.87	3.87	7.19	27.83	9999.00
Motor Group #4	1	CB-542-E-E304	14.80	23.60	0.460	1800	3.47	3.47	8.02	27.83	9999.00
냉각수순환펌프	2	CB-542-E-E304	30.00	46.81	0.460	1800	4.94	4.94	5.63	27.83	9999.00
냉각수 순환펌프	2	CB-542-E-E304	37.00	58.10	0.460	1800	5.49	5.49	5.07	27.83	9999.00

Total Connected Induction Motors (= 15): 1386.0 kVA

Lumped Load Input Data

Lumped Load	Lumped Load Connected Bus	Rating		% Load		Motor Loads							Static Loads	
						Loading		X/R Ratio		% Imp. (Machine Base)			Loading	
ID	ID	kVA	kV	MTR	STAT	kW	kvar	X"/R	X'/R	R	X"	X'	kW	kvar
460V Power	CB-541-E-V201	200.0	0.460	80	20	136.0	84.3	2.38	2.38	8.403	20.00	50.00	34.00	21.07
에어콘	CB-542-E-E005	156.0	0.460	80	20	99.8	74.9	2.38	2.38	8.403	20.00	50.00	24.96	18.72
전동대차	CB-542-E-E002	25.0	0.460	80	20	16.0	12.0	2.38	2.38	8.403	20.00	50.00	4.00	3.00
항온항습기등	CB-542-E-E003	40.0	0.460	50	50	16.0	12.0	2.38	2.38	8.403	20.00	50.00	16.00	12.00
EMER. MCC	CB-542-E-E001	100.0	0.460	80	20	64.0	48.0	2.38	2.38	8.403	20.00	50.00	16.00	12.00
Lump Load #1	CB-542-E-E001	133.0	0.460	70	30	74.5	55.9	2.38	2.38	8.403	20.00	50.00	31.92	23.94

Total Connected Lumped Loads (= 6): 654.0 kVA

[redacted]

3-phase fault at bus: 110V Power (가이드홀)

Prefault voltage = 0.110 = 100.00% of nominal bus kV (0.110 kV)
= 100.00 % of base (0.110 kV)

[redacted] [redacted]

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
110V Power (가이드홀)	Total	0.00	3.715	-18.260	4.9	18.634
CB-541-E-V201	110V Power (가이드홀)	85.21	3.715	-18.260	4.9	18.634
110V Power (실험실)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
220V Power (가이드홀)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
220V Power (실험실)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
CB-531-E-Z001	CB-541-E-V201	97.43	0.754	-3.938	5.2	4.010
CB-540-E-L201	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
460V Power	CB-541-E-V201	100.00	0.060	-0.124	2.1	0.137
Motor Group #3	CB-542-E-E003	100.00	0.015	-0.073	4.8	0.075
항온항습기등	CB-542-E-E003	100.00	0.007	-0.015	2.1	0.017
Motor Group #2	CB-542-E-E002	100.00	0.015	-0.071	4.8	0.072
Guide hall Sup fan A	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Guide hall Sup fan B	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Overhead Crane	CB-542-E-E002	100.00	0.015	-0.070	4.8	0.072
전동대차	CB-542-E-E002	100.00	0.007	-0.015	2.1	0.017

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: 110V Power (실험실)

Prefault voltage = 0.110 = 100.00% of nominal bus kV (0.110 kV)
= 100.00 % of base (0.110 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
110V Power (실험실)	Total	0.00	3.715	-18.260	4.9	18.634
CB-541-E-V201	110V Power (실험실)	85.21	3.715	-18.260	4.9	18.634
110V Power (가이드홀)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
220V Power (가이드홀)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
220V Power (실험실)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
CB-531-E-Z001	CB-541-E-V201	97.43	0.754	-3.938	5.2	4.010
CB-540-E-L201	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
460V Power	CB-541-E-V201	100.00	0.060	-0.124	2.1	0.137
Motor Group #3	CB-542-E-E003	100.00	0.015	-0.073	4.8	0.075
항온항습기등	CB-542-E-E003	100.00	0.007	-0.015	2.1	0.017
Motor Group #2	CB-542-E-E002	100.00	0.015	-0.071	4.8	0.072
Guide hall Sup fan A	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Guide hall Sup fan B	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Overhead Crane	CB-542-E-E002	100.00	0.015	-0.070	4.8	0.072
전동대차	CB-542-E-E002	100.00	0.007	-0.015	2.1	0.017

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: 190/110 Panel(연구동)

Prefault voltage = 0.110 = 100.00% of nominal bus kV (0.110 kV)
= 100.00 % of base (0.110 kV)

[redacted]

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
190/110 Panel(연구동)	Total	0.00	2.146	-2.523	1.2	3.312
CB-542-E-E304	190/110 Panel(연구동)	96.77	2.146	-2.523	1.2	3.312
Motor Group #4	CB-542-E-E304	100.00	0.003	-0.003	1.0	0.004
냉각수순환펌프	CB-542-E-E304	100.00	0.010	-0.012	1.1	0.016
냉각수 순환펌프	CB-542-E-E304	100.00	0.013	-0.015	1.2	0.019
CB-531-E-Z001	CB-541-E-V301	99.61	0.462	-0.555	1.2	0.722
CB-540-E-L301	CB-541-E-V301	96.77	0.000	0.000	999.9	0.000
Motor Group #5	CB-542-E-E005	100.00	0.003	-0.003	1.0	0.005
에어콘	CB-542-E-E005	100.00	0.022	-0.016	0.8	0.027

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: 190V/110V Panel(부속기기

Prefault voltage = 0.110 = 100.00% of nominal bus kV (0.110 kV)
= 100.00 % of base (0.110 kV)

[redacted]

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
190V/110V Panel(부속기기	Total	0.00	0.376	-0.934	2.5	1.006
CB-542-E-E001	190V/110V Panel(부속기기	99.06	0.376	-0.934	2.5	1.006
CB-540-E-L101	CB-542-E-E001	99.06	0.000	0.000	999.9	0.000
Motor Group #1	CB-542-E-E001	100.00	0.002	-0.005	2.6	0.005
Air Compressor	CB-542-E-E001	100.00	0.003	-0.009	2.9	0.009
Cooling Water	CB-542-E-E001	100.00	0.003	-0.008	2.9	0.009
EMER. MCC	CB-542-E-E001	100.00	0.003	-0.004	1.4	0.004
Lump Load #1	CB-542-E-E001	100.00	0.003	-0.004	1.4	0.005
CB-531-E-Z001	CB-541-E-V101	99.88	0.070	-0.170	2.4	0.184
Air Compressor(냉동기)	CB-541-E-V101	100.00	0.007	-0.023	3.4	0.024

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: 220V Power (가이드홀)

Prefault voltage = 0.220 = 100.00% of nominal bus kV (0.220 kV)
= 100.00 % of base (0.220 kV)

[redacted]

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
220V Power (가이드홀)	Total	0.00	1.857	-9.130	4.9	9.317
CB-541-E-V201	220V Power (가이드홀)	85.21	1.857	-9.130	4.9	9.317
110V Power (가이드홀)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
110V Power (실험실)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
220V Power (실험실)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
CB-531-E-Z001	CB-541-E-V201	97.43	0.754	-3.938	5.2	4.010
CB-540-E-L201	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
460V Power	CB-541-E-V201	100.00	0.060	-0.124	2.1	0.137
Motor Group #3	CB-542-E-E003	100.00	0.015	-0.073	4.8	0.075
항온항습기등	CB-542-E-E003	100.00	0.007	-0.015	2.1	0.017
Motor Group #2	CB-542-E-E002	100.00	0.015	-0.071	4.8	0.072
Guide hall Sup fan A	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Guide hall Sup fan B	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Overhead Crane	CB-542-E-E002	100.00	0.015	-0.070	4.8	0.072
전동대차	CB-542-E-E002	100.00	0.007	-0.015	2.1	0.017

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: 220V Power (실험실)

Prefault voltage = 0.220 = 100.00% of nominal bus kV (0.220 kV)
= 100.00 % of base (0.220 kV)

[redacted]

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
220V Power (실험실)	Total	0.00	1.857	-9.130	4.9	9.317
CB-541-E-V201	220V Power (실험실)	85.21	1.857	-9.130	4.9	9.317
110V Power (가이드홀)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
110V Power (실험실)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
220V Power (가이드홀)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
CB-531-E-Z001	CB-541-E-V201	97.43	0.754	-3.938	5.2	4.010
CB-540-E-L201	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
460V Power	CB-541-E-V201	100.00	0.060	-0.124	2.1	0.137
Motor Group #3	CB-542-E-E003	100.00	0.015	-0.073	4.8	0.075
항온항습기등	CB-542-E-E003	100.00	0.007	-0.015	2.1	0.017
Motor Group #2	CB-542-E-E002	100.00	0.015	-0.071	4.8	0.072
Guide hall Sup fan A	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Guide hall Sup fan B	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Overhead Crane	CB-542-E-E002	100.00	0.015	-0.070	4.8	0.072
전동대차	CB-542-E-E002	100.00	0.007	-0.015	2.1	0.017

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-531-E-Z001

Prefault voltage = 6.600 = 100.00% of nominal bus kV (6.600 kV)
= 100.00 % of base (6.600 kV)

From Bus ID	To Bus ID	1/2 Cycle % V From Bus	1/2 Cycle kA Real	1/2 Cycle kA Imaginary	1/2 Cycle Imag. /Real	1/2 Cycle kA Symm. Magnitude	1.5 to 4 Cycle % V From Bus	1.5 to 4 Cycle kA Real	1.5 to 4 Cycle kA Imaginary	1.5 to 4 Cycle Imag. /Real	1.5 to 4 Cycle kA Symm. Magnitude
CB-531-E-Z001	Total	0.00	1.421	-10.970	7.7	11.062	0.00	1.342	-10.580	7.9	10.665
MAIN TR. SECONDARY	CB-531-E-Z001	12.09	1.295	-10.347	8.0	10.427	12.09	1.295	-10.347	8.0	10.427
CB-541-E-V101	CB-531-E-Z001	21.29	0.048	-0.320	6.7	0.324	9.76	0.021	-0.147	6.9	0.149
CB-541-E-V201	CB-531-E-Z001	8.47	0.047	-0.188	4.0	0.193	3.10	0.018	-0.068	3.8	0.071
CB-541-E-V301	CB-531-E-Z001	7.91	0.032	-0.116	3.6	0.120	1.32	0.008	-0.019	2.4	0.020
MAIN TR. PRIMARY	MAIN TR. SECONDARY	88.08	1.295	-10.347	8.0	10.427	88.08	1.295	-10.347	8.0	10.427
Air Compressor(냉동기)	CB-541-E-V101	100.00	0.139	-1.982	14.2	1.987	100.00	0.061	-0.909	15.0	0.911
190V/110V Panel(부속기기	CB-542-E-E001	21.29	0.000	0.000	999.9	0.000	9.76	0.000	0.000	999.9	0.000
CB-540-E-L101	CB-542-E-E001	21.29	0.000	0.000	999.9	0.000	9.76	0.000	0.000	999.9	0.000
Motor Group #1	CB-542-E-E001	100.00	0.066	-0.431	6.5	0.436	100.00	0.030	-0.198	6.7	0.200
Air Compressor	CB-542-E-E001	100.00	0.087	-0.761	8.7	0.766	100.00	0.039	-0.349	9.0	0.351
Cooling Water	CB-542-E-E001	100.00	0.084	-0.697	8.3	0.702	100.00	0.038	-0.320	8.5	0.322
EMER. MCC	CB-542-E-E001	100.00	0.143	-0.335	2.3	0.364	100.00	0.065	-0.154	2.4	0.167
Lump Load #1	CB-542-E-E001	100.00	0.167	-0.390	2.3	0.424	100.00	0.076	-0.179	2.4	0.194
110V Power (가이드홀)	CB-541-E-V201	8.47	0.000	0.000	999.9	0.000	3.10	0.000	0.000	999.9	0.000
110V Power (실험실)	CB-541-E-V201	8.47	0.000	0.000	999.9	0.000	3.10	0.000	0.000	999.9	0.000
220V Power (가이드홀)	CB-541-E-V201	8.47	0.000	0.000	999.9	0.000	3.10	0.000	0.000	999.9	0.000
220V Power (실험실)	CB-541-E-V201	8.47	0.000	0.000	999.9	0.000	3.10	0.000	0.000	999.9	0.000
CB-540-E-L201	CB-541-E-V201	8.47	0.000	0.000	999.9	0.000	3.10	0.000	0.000	999.9	0.000
460V Power	CB-541-E-V201	100.00	0.321	-0.785	2.4	0.848	100.00	0.138	-0.331	2.4	0.359
Motor Group #3	CB-542-E-E003	100.00	0.066	-0.458	7.0	0.463	100.00	0.029	-0.194	6.7	0.196
항온항습기등	CB-542-E-E003	100.00	0.040	-0.098	2.4	0.106	100.00	0.017	-0.041	2.4	0.045
Motor Group #2	CB-542-E-E002	100.00	0.065	-0.442	6.8	0.447	100.00	0.028	-0.187	6.6	0.189
Guide hall Sup fan A	CB-542-E-E002	100.00	0.036	-0.186	5.2	0.189	100.00	0.000	-0.001	5.0	0.001
Guide hall Sup fan B	CB-542-E-E002	100.00	0.036	-0.186	5.2	0.189	100.00	0.000	-0.001	5.0	0.001
Overhead Crane	CB-542-E-E002	100.00	0.064	-0.438	6.8	0.443	100.00	0.028	-0.185	6.5	0.187
전동대차	CB-542-E-E002	100.00	0.040	-0.098	2.4	0.106	100.00	0.017	-0.041	2.4	0.045
CB-540-E-L301	CB-541-E-V301	7.91	0.000	0.000	999.9	0.000	1.32	0.000	0.000	999.9	0.000
Motor Group #5	CB-542-E-E005	100.00	0.029	-0.116	4.0	0.119	100.00	0.000	0.000	3.9	0.000
에어콘	CB-542-E-E005	100.00	0.252	-0.615	2.4	0.665	100.00	0.110	-0.263	2.4	0.285
190/110 Panel(연구동)	CB-542-E-E304	7.91	0.000	0.000	999.9	0.000	1.32	0.000	0.000	999.9	0.000
Motor Group #4	CB-542-E-E304	100.00	0.025	-0.091	3.6	0.094	100.00	0.000	0.000	3.5	0.000
냉각수순환펌프	CB-542-E-E304	100.00	0.072	-0.374	5.2	0.381	100.00	0.000	-0.001	5.0	0.001
냉각수 순환펌프	CB-542-E-E304	100.00	0.081	-0.468	5.8	0.475	100.00	0.000	-0.001	5.6	0.001

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-540-E-L101

Prefault voltage = 0.220 = 100.00% of nominal bus kV (0.220 kV)
= 100.00 % of base (0.220 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-540-E-L101	Total	0.00	0.605	-1.526	2.5	1.641
CB-542-E-E001	CB-540-E-L101	96.94	0.605	-1.526	2.5	1.641
190V/110V Panel(부속기기	CB-542-E-E001	96.94	0.000	0.000	999.9	0.000
Motor Group #1	CB-542-E-E001	100.00	0.006	-0.016	2.6	0.017
Air Compressor	CB-542-E-E001	100.00	0.010	-0.029	3.0	0.031
Cooling Water	CB-542-E-E001	100.00	0.009	-0.026	2.9	0.028
EMER. MCC	CB-542-E-E001	100.00	0.008	-0.012	1.4	0.015
Lump Load #1	CB-542-E-E001	100.00	0.010	-0.014	1.4	0.017
CB-531-E-Z001	CB-541-E-V101	99.62	0.224	-0.556	2.5	0.600
Air Compressor(냉동기)	CB-541-E-V101	100.00	0.022	-0.076	3.5	0.079

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-540-E-L201

Prefault voltage = 0.220 = 100.00% of nominal bus kV (0.220 kV)
= 100.00 % of base (0.220 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-540-E-L201	Total	0.00	1.857	-9.130	4.9	9.317
CB-541-E-V201	CB-540-E-L201	85.21	1.857	-9.130	4.9	9.317
110V Power (가이드홀)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
110V Power (실험실)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
220V Power (가이드홀)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
220V Power (실험실)	CB-541-E-V201	85.21	0.000	0.000	999.9	0.000
CB-531-E-Z001	CB-541-E-V201	97.43	0.754	-3.938	5.2	4.010
460V Power	CB-541-E-V201	100.00	0.060	-0.124	2.1	0.137
Motor Group #3	CB-542-E-E003	100.00	0.015	-0.073	4.8	0.075
항온항습기등	CB-542-E-E003	100.00	0.007	-0.015	2.1	0.017
Motor Group #2	CB-542-E-E002	100.00	0.015	-0.071	4.8	0.072
Guide hall Sup fan A	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Guide hall Sup fan B	CB-542-E-E002	100.00	0.008	-0.030	3.9	0.031
Overhead Crane	CB-542-E-E002	100.00	0.015	-0.070	4.8	0.072
전동대차	CB-542-E-E002	100.00	0.007	-0.015	2.1	0.017

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-540-E-L301

Prefault voltage = 0.220 = 100.00% of nominal bus kV (0.220 kV)
= 100.00 % of base (0.220 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-540-E-L301	Total	0.00	1.765	-8.578	4.9	8.758
CB-541-E-V301	CB-540-E-L301	80.09	1.765	-8.578	4.9	8.758
CB-531-E-Z001	CB-541-E-V301	97.57	0.732	-3.747	5.1	3.817
Motor Group #5	CB-542-E-E005	100.00	0.007	-0.025	3.5	0.026
에어콘	CB-542-E-E005	100.00	0.059	-0.131	2.2	0.144
190/110 Panel(연구동)	CB-542-E-E304	80.09	0.000	0.000	999.9	0.000
Motor Group #4	CB-542-E-E304	100.00	0.006	-0.019	3.1	0.020
냉각수순환펌프	CB-542-E-E304	100.00	0.019	-0.080	4.3	0.082
냉각수 순환펌프	CB-542-E-E304	100.00	0.021	-0.100	4.8	0.103

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-541-E-V101

Prefault voltage = 0.460 = 100.00% of nominal bus kV (0.460 kV)
= 100.00 % of base (0.460 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-541-E-V101	Total	0.00	3.990	-24.703	6.2	25.023
CB-531-E-Z001	CB-541-E-V101	87.60	3.154	-18.859	6.0	19.121
Air Compressor(냉동기)	CB-541-E-V101	100.00	0.161	-2.519	15.6	2.524
190V/110V Panel(부속기기	CB-542-E-E001	0.00	0.000	0.000	999.9	0.000
CB-540-E-L101	CB-542-E-E001	0.00	0.000	0.000	999.9	0.000
Motor Group #1	CB-542-E-E001	100.00	0.080	-0.548	6.8	0.554
Air Compressor	CB-542-E-E001	100.00	0.105	-0.968	9.2	0.973
Cooling Water	CB-542-E-E001	100.00	0.102	-0.886	8.7	0.892
EMER. MCC	CB-542-E-E001	100.00	0.179	-0.427	2.4	0.463
Lump Load #1	CB-542-E-E001	100.00	0.209	-0.497	2.4	0.539
MAIN TR. SECONDARY	CB-531-E-Z001	89.00	0.209	-1.277	6.1	1.294
CB-541-E-V201	CB-531-E-Z001	88.64	0.007	-0.023	3.5	0.024
CB-541-E-V301	CB-531-E-Z001	88.57	0.005	-0.014	3.2	0.015
CB-542-E-E001	CB-541-E-V101	0.00	0.674	-3.325	4.9	3.392

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-541-E-V201

Prefault voltage = 0.460 = 100.00% of nominal bus kV (0.460 kV)
= 100.00 % of base (0.460 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-541-E-V201	Total	0.00	4.470	-29.737	6.7	30.071
110V Power (가이드홀)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
110V Power (실험실)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
220V Power (가이드홀)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
220V Power (실험실)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
CB-531-E-Z001	CB-541-E-V201	82.65	3.713	-26.805	7.2	27.061
CB-540-E-L201	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
460V Power	CB-541-E-V201	100.00	0.359	-0.853	2.4	0.926
Motor Group #3	CB-542-E-E003	100.00	0.077	-0.500	6.5	0.506
항온항습기등	CB-542-E-E003	100.00	0.045	-0.107	2.4	0.116
Motor Group #2	CB-542-E-E002	100.00	0.075	-0.482	6.4	0.488
Guide hall Sup fan A	CB-542-E-E002	100.00	0.041	-0.203	4.9	0.207
Guide hall Sup fan B	CB-542-E-E002	100.00	0.041	-0.203	4.9	0.207
Overhead Crane	CB-542-E-E002	100.00	0.075	-0.478	6.4	0.484
전동대차	CB-542-E-E002	100.00	0.045	-0.107	2.4	0.116
MAIN TR. SECONDARY	CB-531-E-Z001	84.58	0.244	-1.793	7.3	1.809
CB-541-E-V101	CB-531-E-Z001	86.34	0.009	-0.055	6.2	0.056
CB-541-E-V301	CB-531-E-Z001	84.01	0.006	-0.020	3.5	0.021
CB-542-E-E002	CB-541-E-V201	0.00	0.277	-1.472	5.3	1.498
CB-542-E-E003	CB-541-E-V201	0.00	0.121	-0.606	5.0	0.618

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-541-E-V301

Prefault voltage = 0.460 = 100.00% of nominal bus kV (0.460 kV)
= 100.00 % of base (0.460 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-541-E-V301	Total	0.00	3.676	-20.705	5.6	21.029
CB-531-E-Z001	CB-541-E-V301	87.80	3.161	-18.903	6.0	19.166
CB-540-E-L301	CB-541-E-V301	0.00	0.000	0.000	999.9	0.000
Motor Group #5	CB-542-E-E005	100.00	0.032	-0.125	3.9	0.129
에어콘	CB-542-E-E005	100.00	0.280	-0.666	2.4	0.722
190/110 Panel(연구동)	CB-542-E-E304	0.00	0.000	0.000	999.9	0.000
Motor Group #4	CB-542-E-E304	100.00	0.028	-0.098	3.5	0.102
냉각수순환펌프	CB-542-E-E304	100.00	0.082	-0.406	4.9	0.414
냉각수 순환펌프	CB-542-E-E304	100.00	0.092	-0.507	5.5	0.515
MAIN TR. SECONDARY	CB-531-E-Z001	89.18	0.206	-1.256	6.1	1.273
CB-541-E-V101	CB-531-E-Z001	90.40	0.007	-0.039	5.3	0.040
CB-541-E-V201	CB-531-E-Z001	88.83	0.007	-0.023	3.5	0.024
CB-542-E-E304	CB-541-E-V301	0.00	0.203	-1.011	5.0	1.031
CB-542-E-E005	CB-541-E-V301	0.00	0.312	-0.791	2.5	0.850

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-542-E-E001

Prefault voltage = 0.460 = 100.00% of nominal bus kV (0.460 kV)
= 100.00 % of base (0.460 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-542-E-E001	Total	0.00	3.990	-24.703	6.2	25.023
190V/110V Panel(부속기기	CB-542-E-E001	0.00	0.000	0.000	999.9	0.000
CB-540-E-L101	CB-542-E-E001	0.00	0.000	0.000	999.9	0.000
Motor Group #1	CB-542-E-E001	100.00	0.080	-0.548	6.8	0.554
Air Compressor	CB-542-E-E001	100.00	0.105	-0.968	9.2	0.973
Cooling Water	CB-542-E-E001	100.00	0.102	-0.886	8.7	0.892
EMER. MCC	CB-542-E-E001	100.00	0.179	-0.427	2.4	0.463
Lump Load #1	CB-542-E-E001	100.00	0.209	-0.497	2.4	0.539
CB-531-E-Z001	CB-541-E-V101	87.60	3.154	-18.859	6.0	19.121
Air Compressor(냉동기)	CB-541-E-V101	100.00	0.161	-2.519	15.6	2.524
MAIN TR. SECONDARY	CB-531-E-Z001	89.00	0.209	-1.277	6.1	1.294
CB-541-E-V201	CB-531-E-Z001	88.64	0.007	-0.023	3.5	0.024
CB-541-E-V301	CB-531-E-Z001	88.57	0.005	-0.014	3.2	0.015
CB-541-E-V101	CB-542-E-E001	0.00	3.316	-21.378	6.4	21.633

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-542-E-E002

Prefault voltage = 0.460 = 100.00% of nominal bus kV (0.460 kV)
= 100.00 % of base (0.460 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-542-E-E002	Total	0.00	4.470	-29.737	6.7	30.071
Motor Group #2	CB-542-E-E002	100.00	0.075	-0.482	6.4	0.488
Guide hall Sup fan A	CB-542-E-E002	100.00	0.041	-0.203	4.9	0.207
Guide hall Sup fan B	CB-542-E-E002	100.00	0.041	-0.203	4.9	0.207
Overhead Crane	CB-542-E-E002	100.00	0.075	-0.478	6.4	0.484
전동대차	CB-542-E-E002	100.00	0.045	-0.107	2.4	0.116
110V Power (가이드홀)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
110V Power (실험실)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
220V Power (가이드홀)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
220V Power (실험실)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
CB-531-E-Z001	CB-541-E-V201	82.65	3.713	-26.805	7.2	27.061
CB-540-E-L201	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
460V Power	CB-541-E-V201	100.00	0.359	-0.853	2.4	0.926
Motor Group #3	CB-542-E-E003	100.00	0.077	-0.500	6.5	0.506
항온항습기등	CB-542-E-E003	100.00	0.045	-0.107	2.4	0.116
MAIN TR. SECONDARY	CB-531-E-Z001	84.58	0.244	-1.793	7.3	1.809
CB-541-E-V101	CB-531-E-Z001	86.34	0.009	-0.055	6.2	0.056
CB-541-E-V301	CB-531-E-Z001	84.01	0.006	-0.020	3.5	0.021
CB-541-E-V201	CB-542-E-E002	0.00	4.193	-28.265	6.7	28.574
CB-542-E-E003	CB-541-E-V201	0.00	0.121	-0.606	5.0	0.618

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-542-E-E003

Prefault voltage = 0.460 = 100.00% of nominal bus kV (0.460 kV)
= 100.00 % of base (0.460 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-542-E-E003	Total	0.00	4.470	-29.737	6.7	30.071
Motor Group #3	CB-542-E-E003	100.00	0.077	-0.500	6.5	0.506
항온항습기등	CB-542-E-E003	100.00	0.045	-0.107	2.4	0.116
110V Power (가이드홀)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
110V Power (실험실)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
220V Power (가이드홀)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
220V Power (실험실)	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
CB-531-E-Z001	CB-541-E-V201	82.65	3.713	-26.805	7.2	27.061
CB-540-E-L201	CB-541-E-V201	0.00	0.000	0.000	999.9	0.000
460V Power	CB-541-E-V201	100.00	0.359	-0.853	2.4	0.926
Motor Group #2	CB-542-E-E002	100.00	0.075	-0.482	6.4	0.488
Guide hall Sup fan A	CB-542-E-E002	100.00	0.041	-0.203	4.9	0.207
Guide hall Sup fan B	CB-542-E-E002	100.00	0.041	-0.203	4.9	0.207
Overhead Crane	CB-542-E-E002	100.00	0.075	-0.478	6.4	0.484
전동대차	CB-542-E-E002	100.00	0.045	-0.107	2.4	0.116
MAIN TR. SECONDARY	CB-531-E-Z001	84.58	0.244	-1.793	7.3	1.809
CB-541-E-V101	CB-531-E-Z001	86.34	0.009	-0.055	6.2	0.056
CB-541-E-V301	CB-531-E-Z001	84.01	0.006	-0.020	3.5	0.021
CB-542-E-E002	CB-541-E-V201	0.00	0.277	-1.472	5.3	1.498
CB-541-E-V201	CB-542-E-E003	0.00	4.349	-29.131	6.7	29.454

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-542-E-E005

Prefault voltage = 0.460 = 100.00% of nominal bus kV (0.460 kV)
= 100.00 % of base (0.460 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-542-E-E005	Total	0.00	3.676	-20.705	5.6	21.029
Motor Group #5	CB-542-E-E005	100.00	0.032	-0.125	3.9	0.129
에어콘	CB-542-E-E005	100.00	0.280	-0.666	2.4	0.722
CB-531-E-Z001	CB-541-E-V301	87.80	3.161	-18.903	6.0	19.166
CB-540-E-L301	CB-541-E-V301	0.00	0.000	0.000	999.9	0.000
190/110 Panel(연구동)	CB-542-E-E304	0.00	0.000	0.000	999.9	0.000
Motor Group #4	CB-542-E-E304	100.00	0.028	-0.098	3.5	0.102
냉각수순환펌프	CB-542-E-E304	100.00	0.082	-0.406	4.9	0.414
냉각수 순환펌프	CB-542-E-E304	100.00	0.092	-0.507	5.5	0.515
MAIN TR. SECONDARY	CB-531-E-Z001	89.18	0.206	-1.256	6.1	1.273
CB-541-E-V101	CB-531-E-Z001	90.40	0.007	-0.039	5.3	0.040
CB-541-E-V201	CB-531-E-Z001	88.83	0.007	-0.023	3.5	0.024
CB-542-E-E304	CB-541-E-V301	0.00	0.203	-1.011	5.0	1.031
CB-541-E-V301	CB-542-E-E005	0.00	3.364	-19.914	5.9	20.196

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: CB-542-E-E304

Prefault voltage = 0.460 = 100.00% of nominal bus kV (0.460 kV)
= 100.00 % of base (0.460 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
CB-542-E-E304	Total	0.00	3.676	-20.705	5.6	21.029
190/110 Panel(연구동)	CB-542-E-E304	0.00	0.000	0.000	999.9	0.000
Motor Group #4	CB-542-E-E304	100.00	0.028	-0.098	3.5	0.102
냉각수순환펌프	CB-542-E-E304	100.00	0.082	-0.406	4.9	0.414
냉각수 순환펌프	CB-542-E-E304	100.00	0.092	-0.507	5.5	0.515
CB-531-E-Z001	CB-541-E-V301	87.80	3.161	-18.903	6.0	19.166
CB-540-E-L301	CB-541-E-V301	0.00	0.000	0.000	999.9	0.000
Motor Group #5	CB-542-E-E005	100.00	0.032	-0.125	3.9	0.129
에어콘	CB-542-E-E005	100.00	0.280	-0.666	2.4	0.722
MAIN TR. SECONDARY	CB-531-E-Z001	89.18	0.206	-1.256	6.1	1.273
CB-541-E-V101	CB-531-E-Z001	90.40	0.007	-0.039	5.3	0.040
CB-541-E-V201	CB-531-E-Z001	88.83	0.007	-0.023	3.5	0.024
CB-541-E-V301	CB-542-E-E304	0.00	3.473	-19.694	5.7	19.998
CB-542-E-E005	CB-541-E-V301	0.00	0.312	-0.791	2.5	0.850

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: MAIN TR. PRIMARY

Prefault voltage = 22.900 = 100.00% of nominal bus kV (22.900 kV)
= 100.00 % of base (22.900 kV)

From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
MAIN TR. PRIMARY	Total	0.00	2.543	-25.257	9.9	25.385	0.00	2.522	-25.153	10.0	25.279
MAIN TR. SECONDARY	MAIN TR. PRIMARY	4.47	0.034	-0.171	5.0	0.174	1.73	0.013	-0.066	5.0	0.067
FROM KAERI S/S	MAIN TR. PRIMARY	100.00	2.509	-25.087	10.0	25.212	100.00	2.509	-25.087	10.0	25.212
CB-531-E-Z001	MAIN TR. SECONDARY	5.10	0.118	-0.593	5.0	0.604	1.98	0.046	-0.229	5.0	0.234

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

3-phase fault at bus: MAIN TR. SECONDARY

Prefault voltage = 6.600 = 100.00% of nominal bus kV (6.600 kV)
= 100.00 % of base (6.600 kV)

[redacted]		[redacted]					[redacted]				
From Bus ID	To Bus ID	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude	% V From Bus	kA Real	kA Imaginary	Imag. /Real	kA Symm. Magnitude
MAIN TR. SECONDARY	Total	0.00	0.936	-12.295	13.1	12.330	0.00	0.856	-11.909	13.9	11.940
CB-531-E-Z001	MAIN TR. SECONDARY	0.73	0.127	-0.619	4.9	0.632	0.28	0.047	-0.233	4.9	0.238
MAIN TR. PRIMARY	MAIN TR. SECONDARY	86.63	0.809	-11.676	14.4	11.703	86.63	0.809	-11.676	14.4	11.703
CB-541-E-V101	CB-531-E-Z001	21.84	0.048	-0.318	6.6	0.322	10.00	0.022	-0.147	6.8	0.148
CB-541-E-V201	CB-531-E-Z001	9.08	0.047	-0.186	4.0	0.192	3.34	0.018	-0.068	3.8	0.071
CB-541-E-V301	CB-531-E-Z001	8.52	0.032	-0.115	3.6	0.119	1.56	0.008	-0.019	2.4	0.020
FROM KAERI S/S	MAIN TR. PRIMARY	100.00	0.233	-3.365	14.4	3.373	100.00	0.233	-3.365	14.4	3.373

NACD Ratio = 1.00

[redacted]

If faulted bus is involved in loops formed by protection devices, the short-circuit contributions through these PDs will not be reported.

Momentary Duty Summary Report

3-Phase Fault Currents: (Prefault Voltage = 100 % of the Bus Nominal Voltage)

Bus		Source		Momentary Duty					Source Contribution		
ID	kV	ID	Type	Symm. kA rms	X/R Ratio	M.F.	Asymm. kA rms	Asymm. kA Crest	Symm. kA rms	Asymm. kA rms	Asymm. kA Crest
110V Power (가이드홀)	0.110	110V Power (가이드홀)	Bus	18.634	4.9	1.249	23.278	40.303			
110V Power (실험실)	0.110	110V Power (실험실)	Bus	18.634	4.9	1.249	23.278	40.303			
190/110 Panel(연구동)	0.110	190/110 Panel(연구동)	Bus	3.312	1.2	1.005	3.328	5.008			
190V/110V Panel(부속기기	0.110	190V/110V Panel(부속기기?	Bus	1.006	2.5	1.077	1.084	1.825			
220V Power (가이드홀)	0.220	220V Power (가이드홀)	Bus	9.317	4.9	1.249	11.639	20.152			
220V Power (실험실)	0.220	220V Power (실험실)	Bus	9.317	4.9	1.249	11.639	20.152			
CB-531-E-Z001	6.600	CB-531-E-Z001	Bus	11.062	7.9	1.380	15.264	26.162			
CB-540-E-L101	0.220	CB-540-E-L101	Bus	1.641	2.5	1.080	1.772	2.990			
CB-540-E-L201	0.220	CB-540-E-L201	Bus	9.317	4.9	1.249	11.639	20.152			
CB-540-E-L301	0.220	CB-540-E-L301	Bus	8.758	4.9	1.246	10.913	18.896			
CB-541-E-V101	0.460	CB-541-E-V101	Bus	25.023	7.0	1.348	33.743	58.025			
CB-541-E-V201	0.460	CB-541-E-V201	Bus	30.071	7.0	1.346	40.474	69.617			
CB-541-E-V301	0.460	CB-541-E-V301	Bus	21.029	5.8	1.295	27.231	47.040			
CB-542-E-E001	0.460	CB-542-E-E001	Bus	25.023	7.0	1.348	33.743	58.025			
CB-542-E-E002	0.460	CB-542-E-E002	Bus	30.071	7.0	1.346	40.474	69.617			
CB-542-E-E003	0.460	CB-542-E-E003	Bus	30.071	7.0	1.346	40.474	69.617			
CB-542-E-E005	0.460	CB-542-E-E005	Bus	21.029	5.8	1.295	27.231	47.040			
CB-542-E-E304	0.460	CB-542-E-E304	Bus	21.029	5.8	1.295	27.231	47.040			
MAIN TR. PRIMARY	22.900	MAIN TR. PRIMARY	Bus	25.385	10.0	1.437	36.482	62.102			
MAIN TR. SECONDARY	6.600	MAIN TR. SECONDARY	Bus	12.330	14.0	1.509	18.609	31.376			

Method:IEEE - X/R is calculated from separate R & X networks.

Protective device duty is calculated based on total fault current

[redacted]

3-Phase Fault Currents: (Prefault Voltage = 100 % of the Bus Nominal Voltage)

[redacted]		[redacted]			[redacted]				[redacted]			
ID	kV	ID	Type	CPT (Cy)	Symm. kA rms	X/R Ratio	M.F.	Adj. Sym. kA rms	kV	Test PF	Rated Int.	Adjusted Int.
110V Power (가이드홀)	0.110				18.634	4.9						
110V Power (실험실)	0.110				18.634	4.9						
190/110 Panel(연구동)	0.110				3.312	1.2						
190V/110V Panel(부속기기	0.110				1.006	2.5						
220V Power (가이드홀)	0.220				9.317	4.9						
220V Power (실험실)	0.220				9.317	4.9						
CB-531-E-Z001	6.600				10.665	8.0						
CB-540-E-L101	0.220				1.641	2.5						
CB-540-E-L201	0.220				9.317	4.9						
CB-540-E-L301	0.220				8.758	4.9						
CB-541-E-V101	0.460				25.023	7.0						
CB-541-E-V201	0.460				30.071	7.0						
CB-541-E-V301	0.460				21.029	5.8						
CB-542-E-E001	0.460				25.023	7.0						
CB-542-E-E002	0.460				30.071	7.0						
CB-542-E-E003	0.460				30.071	7.0						
CB-542-E-E005	0.460				21.029	5.8						
CB-542-E-E304	0.460				21.029	5.8						
MAIN TR. PRIMARY	22.900				25.279	10.0						
MAIN TR. SECONDARY	6.600				11.940	14.3						

Method:IEEE - X/R is calculated from separate R & X networks.
HV CB interrupting capability is adjusted based on bus nominal voltage
Short-Circuit multiplying factor for LV Molded Case and Insulated Case Circuit Breakers is calculated based on asymmetrical current.
Generator protective device duty is calculated based on maximum through fault current. Other protective device duty is calculated based on total fault current.

- [redacted]

Interrupting Duty Summary Report
Generator Circuit Breaker

Bus		Device		Peak Symmetrical	@ CB Parting Time	
ID	kV	ID	Type	kA	Degree of Asymm.(%)	DC Fault Current (kA)

서 지 정 보 양 식

수행기관보고서번호	위탁기관보고서번호	표준보고서번호	INIS 주제코드
KAERI/TR-2996/2005			

제목/부제	ETAP을 이용한 하나로 냉중성자원의 전력계통 분석
주저자	김형규(하나로 운영부)
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초록 (15-20줄 내외)

냉중성자원 전력계통에서 변압기의 탭 선정 및 전력계통의 최적 운전 조건을 결정하기 위하여 다양한 운전 조건에 따른 각 모선에서의 전력조류분석, 모터기동분석 및 단락전류 분석을 하였다. 이들 해석은 전력계통 설계 및 해석 프로그램인 ETAP(Electrical Transient Analyzer Program, Ver. 5.0.0)을 이용하여 수행하였다.

전력 조류의 분석은 컴퓨터 모사에 의한 최적 운전 조건을 추적하여 가장 합리적인 운용이 될 수 있도록 하기 위함이다. 전력조류 분석은 다음의 항목들에 대하여 수행하였다.

-. 연구소 변전소로부터의 공급 유효전력, 무효전력량
-. 모선의 전압강하
-. 모선의 유효전력, 무효전력 흐름 분석

모터의 기동전류는 정상 전 부하전류의 5~10배이다. 모터의 기동토크는 인가전압의 제곱에 비례하므로 전압강하가 크면 기동토크를 발생시킬 수 없을 뿐 아니라 운전 중인 모터는 정지할 수 있다. CNS의 최대용량 모터를 제외한 전 부하 운전 중 최대 용량 모터를 기동시켜 각 모선 및 모터 단자전압 강하를 확인하였다.

단락전류의 크기 및 지속시간은 계통의 특성에 종속되며, 사고전류를 감지하고, 사고를 차단, 격리시키기 위한 보호시스템이 요구된다. CNS 전력계통의 보호설계를 위한 최대 단락용량을 결정하고 차단기, 스위치기어의 선정 및 보호계전기 설정을 위한 정보를 제공하기 위하여 단락전류 분석을 하였다.

주제명키워드(10단어내외)	하나로, ETAP, 냉중성자, 전력조류, 모터기동분석, 단락전류

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Title / Subtitle	Analysis of the Electric Power System of HANARO Cold Neutron Source Using ETAP
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Abstract (15-20 Lines)

The analysis of load flow is for searching the optimal operation condition by computer simulation. The analyzed items are as follows.

-. Active and reactive power from KAERI substation
-. Voltage drop on Tus
-. Analysis of load flow of active power and reactive power on Bus

The motor starting current of most ac motors is several times normal full load current. Motor starting torque varies directly as square of the applied voltage. If the terminal voltage drop is excessive, the motor may not have enough starting torque to accelerate up to running speed. Running motors may stall from excessive voltage drops.

Short-circuit studies are done to determine the magnitude of the prospective currents flowing throughout the power system at various time intervals after a fault occurs. Short-circuit studies can be performed at the planning stage in order to help finalize the system layout, determine voltage levels, and size cables, transformers, and conductors. For existing systems, fault studies are necessary in the cases of installation of extra rotating loads, system layout modifications, rearrangement of protection equipment, verification of the adequacy of existing breakers.

This technical report deals with the load flow study, motor starting study and short circuit study for CNS(Cold Neutron Source) power system using ETAP(Electrical Transient Analyzer Program) to determine the optimal operating condition.

Subject Keywords (About 10 words)	HANARO, ETAP, CNS, Cold Neutron Source, Load flow, Motor starting, Short circuit current