Chapter 13

SITE, BUILDING AND INFRASTRUCTURE

13.1 Introduction

The layout of the building is determined by the circumference of the storage ring, the length of the beam lines, the space for the offices, laboratories, workshops and the housing of the infrastructure. The first draft design for the SESAME building has been made in 1998 and is presented in the "Green Book". It is a round building similar to BESSY I. According to the circumference of the machine (~100 m) and the length of the beam lines (~30 meters) the building had a diameter of 80 meters. In order to save space, some parts of the experimental hall should be used for the installation of the infrastructure.

However, the experimental hall of ANKA has a free area of 60mX60m, and this free area is covered with a crane, and its storage ring has a circumference of ca 110.4 meters, which is almost the same size of SESAME. Accordingly, the design of ANKA building was adopted, in addition to the fact that it is easier to construct compared to the round design. Moreover, two floors of reinforced concrete and natural stone were added to fulfil the required laboratories, offices, administration area, control room, library, multipurpose hall, electrical and mechanical workshops… etc.

Five member states proposed sites for the synchrotron light source SESAME. An international selection committee selected as the residence of SESAME the site at Allan in Jordan (see figure (13.1), (13.2) and (13.3)). It is a country site very close to Al-Zai National Park in Al-Balqa Governorate which is about 13Km to the north from Assalt city, 42 km to the northern west of Amman, and 62 km from Amman airport. It can be reached from the airport by taking the highway#25 then highway#35 in the same direction up to Suwaylih Circle, then directing to the west (left hand) through the highway#24 then straight forward in the main road#30, after 18Km from Suwaylih Circle, a secondary road on the right hand will lead after 4 km to the project site directly. It is almost a flat mountain with 800m height from sea level. The site is located in a farming area and has a moderate climate in winter and summer and far from industrial zones. The "Allan-site" is roughly 30km north of Amman, the Capital of Jordan, and is connected to Amman by a main street.

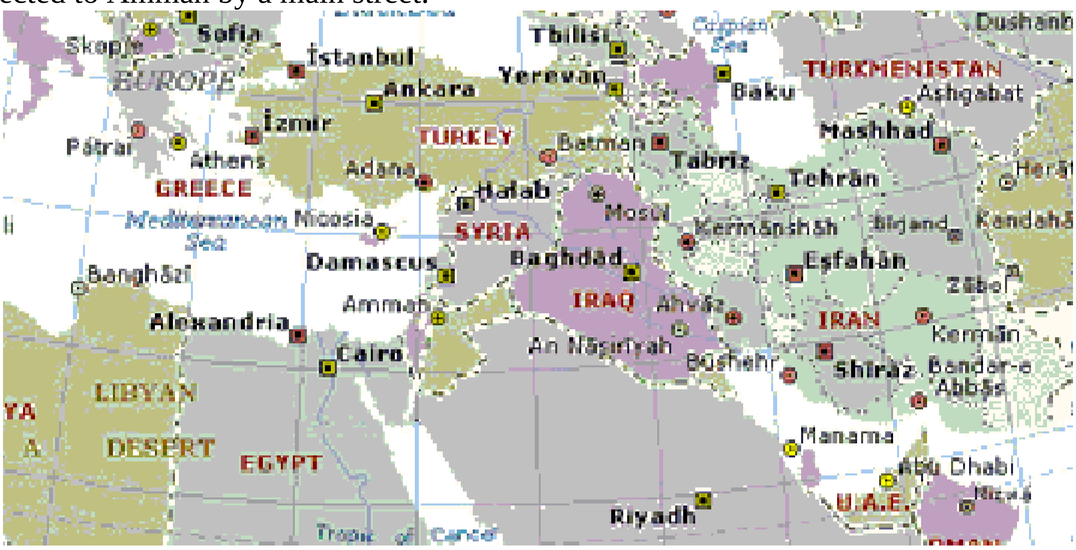


Figure 13.1: The map of the Middle East region, with most the member states of SESAME.

Figure 13.2: The map of Jordan with the surrounding countries.

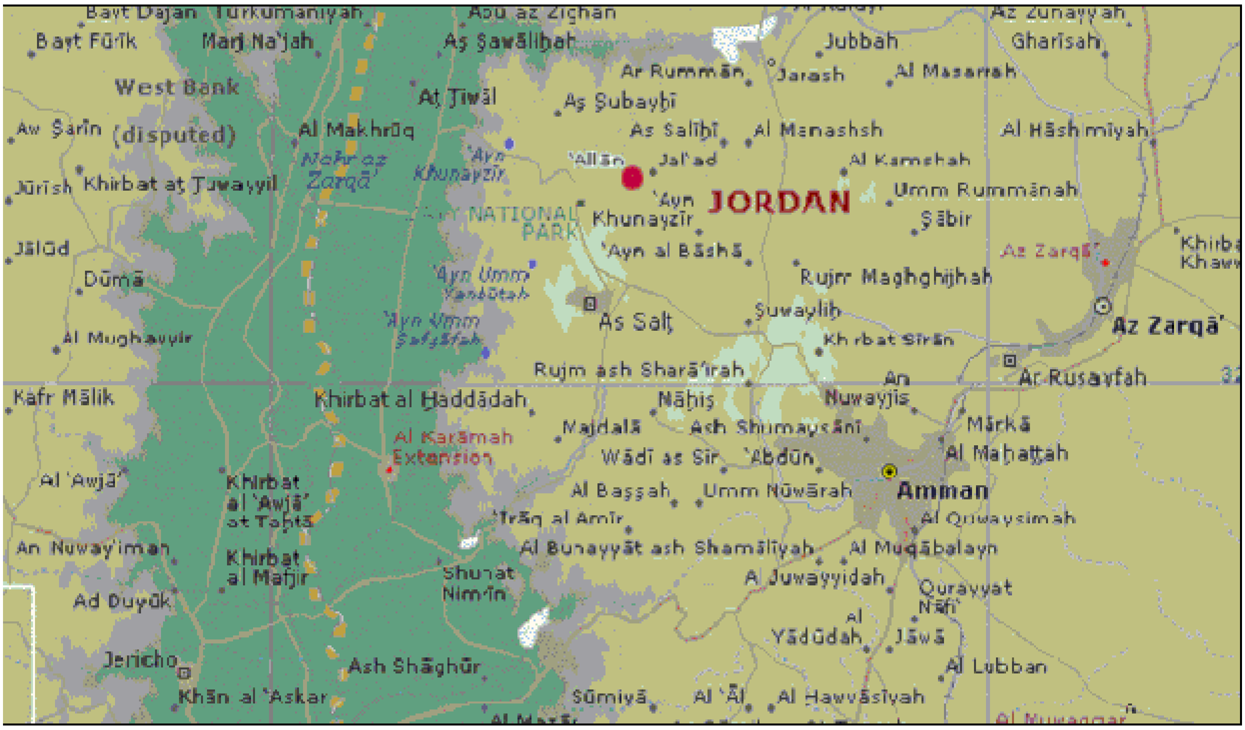


Figure 13.3: The location of SESAME (marked with a red dot) within Jordan.

The estate in Allan belongs to the Al – Balqa Applied University (BAU), where Princess Rahma College, one of the University Colleges, exists. The estate is hilly and covers an area of 104,000 m^2. Figure (13.4) gives an overview of the building site and figure (13.5) presents the topography of the Princess Rahma College with the location of the new SESAME building.

Figure 13.4: An overview of the Princess Rahma College with the building site in front of it.

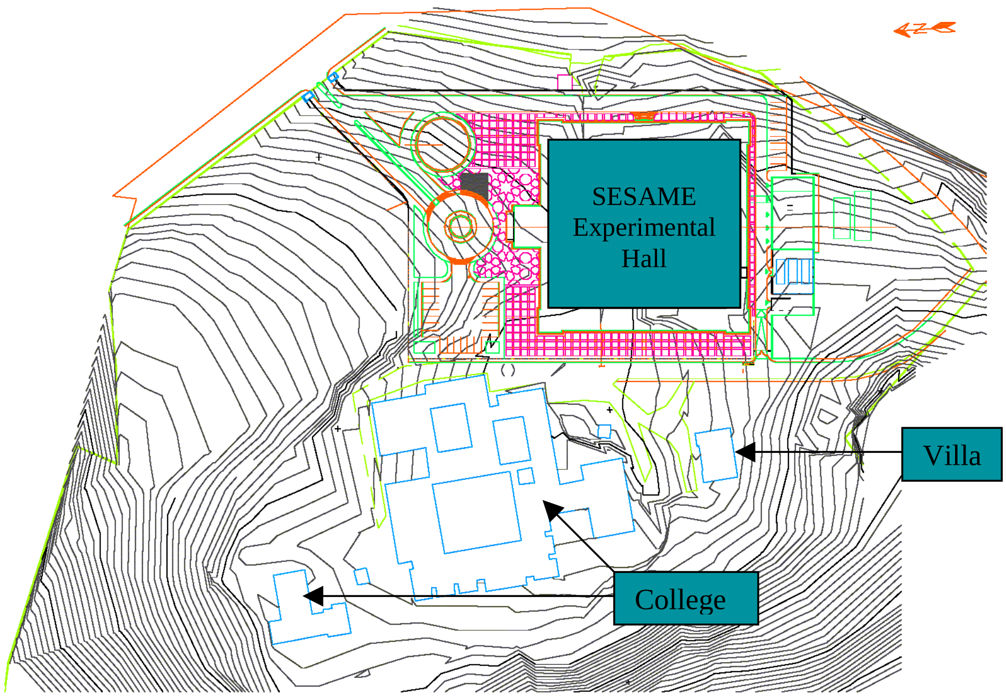


Figure 13.5: Topography of the college site with the location of the SESAME building.

13.2 Site Investigation and Geotechnical Evaluation

A site investigation was conducted for the proposed site for the Synchrotron Project located at Allan area. The investigation included a study of the geology, drilling of boreholes, sampling, carrying out field test including pressure meter and SPT tests, laboratory testing, analysis of the results, geotechnical interpretation of findings and developing conclusions and recommendations to aid the foundation design and construction.

The principal findings and conclusions developed from the investigation were as follow:

The project site lies within a geological formation called Naur Formation formed during the Cretaceous Period. Generally, this formation comprises a sequence of alternating medium hard to hard limestone’s and soft marls. The limestone underlain by less resistant marls may form relief feature and increase the potential of instability, especially in steep slopes and high cuts. Therefore, precautions to protect the deep excavations (if any) shall be considered.

1. The rocks from the above formation were encountered at the expected foundation level approximately at the corners of the site, whereas relatively thick recent soil deposits of brown silty clay cover the remaining areas.
2. The tested physical, chemical and mechanical properties of both rocks from Naur Formation and recent silky clay, indicate that the proposed project is construct able on the study site provided that some recommendations are followed.

Later on, during the design stage carried out by the Engineering Department of BAU, the above recommendations of the site investigation were taken into consideration.

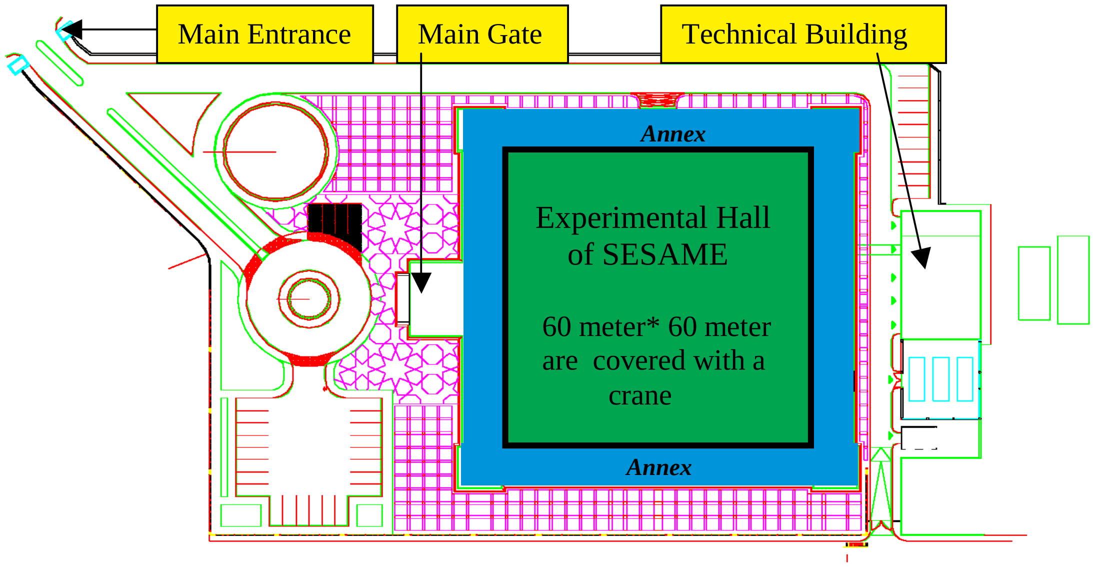


Figure 13.6: The general Layout of the building with main gate, main entrance and the technical building

13.3 Design of Building Foundation

In order to ensure the stability of foundation and floor of the experimental hall, the following factors were considered in the design:

1. In accordance with the site investigation results, and due to the non–homogeneity of the soil, a decision was taken to remove the soil underneath the whole area of the building to a depth of five meters, and to be replaced starting from the bottom, by the following layers:
   - Two meters of selected uniform well – compacted material.
   - Three meters of honey – combed reinforced concrete beams and columns filled with sand.

- Top slab of well – designed reinforced concrete to prevent any vertical or horizontal movement of the floor of the experimental hall. This top slab was deigned without any expansion joints.

2. The foundation of the floor of the experimental hall was designed to be completely isolated from the foundation of the whole building.

Figure (13.7) shows a cross section in the foundation at a steel column.

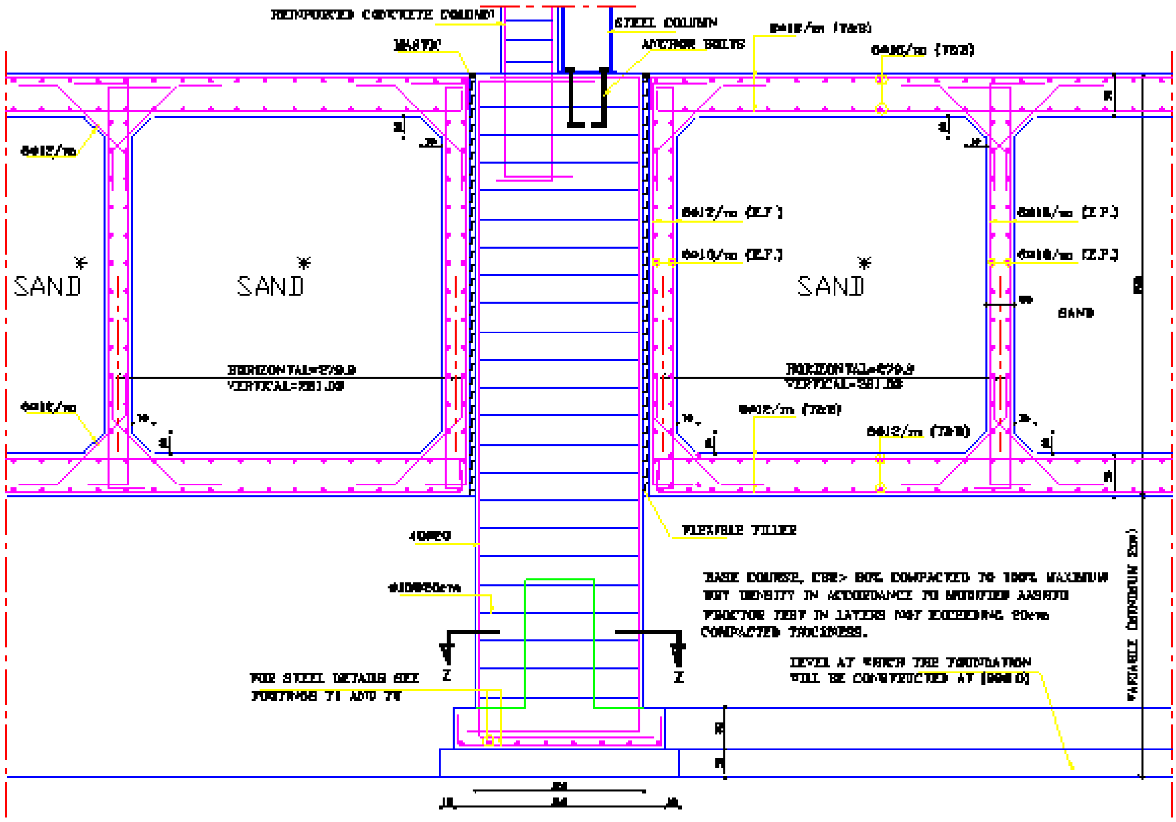


Figure13.7: A cross section in the foundation at steel column.

13.4 The SESAME Building

The general layout of the SESAME building with the main gate, main entrance, the parking spots and the technical building, housing the infrastructure, is presented in figure (13.6). The circumference of the storage ring is roughly the same as for ANKA and hence the central part of the building, the experimental hall, has been taken over from the ANKA design. An area of 60 m * 60 m is covered with a crane. Around the "ANKA - experimental hall" a two store annex has been added for the laboratories, workshops, offices, meeting rooms etc.

Figures (13.8) and (13.9) show the north and east elevation of SESAME building, in respective order, demonstrating the architectural style, and the traditional natural limestone's used commonly in Jordan.

The layout of the ground floor is shown in figure (13.10). The main part of the ground floor is the experimental hall with an overall area of 4473 m^2. At each side of the experimental hall there is a cut-out of annex with an area of 207 m^2 each, which belongs to the experimental hall. The reason for the cut-outs is to increase the length of the beam lines. Around the experimental hall there is a corridor or pathway with a width of 2m.

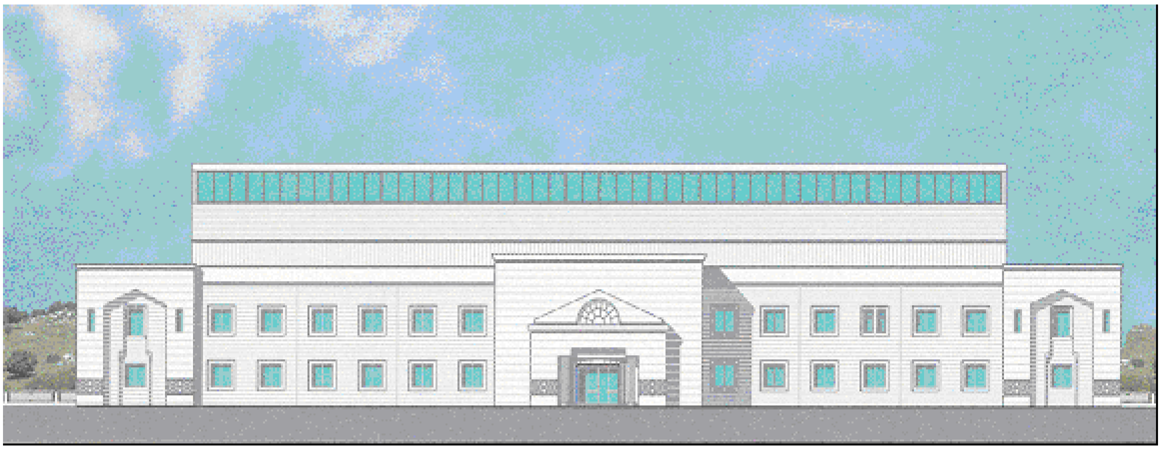


Figure 13.8: North elevation of SESAME building with main entrance.

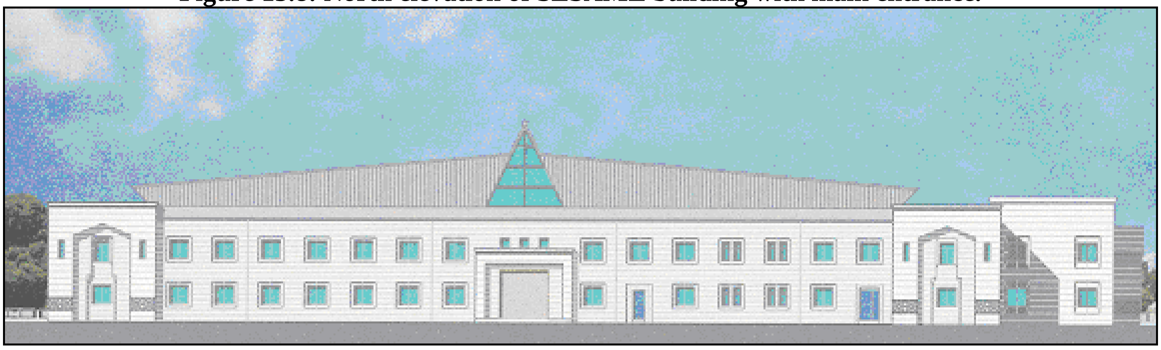


Figure 13.9: East elevation of SESAME building with load entrance.

If it is assumed that the circumference of the machine is 120m, the lengths of the beam lines vary (from the source point to the walls) between 27 m and 32 m. Most of the beam lines have a length of 29 m. According to the existing beam lines at ANKA, this length should be sufficient. All the beam lines at SPEAR and NSLS in Brookhaven have also lengths in this range.

There are workshops and laboratories in each corner of the building. In general, there are 12 large laboratories and one small, with an overall area of 656 m^2. The mechanical workshop has an area of 83m^2 and the electrical workshop of 56 m^2 (see figure (13.10)). Detailed distribution of areas is given in table (13.1). From one side of the building there is an entrance for trucks to unload heavy materials and components, where after it is unloaded with a crane being supplied for this purpose. Both sides are provided with kitchens and toilets, in addition to one staircase connecting the first floor.

The ground Floor area of the building is 5704 m^2 including the 4473 m^2 of the experimental hall area. Converting this area of the experimental hall to a circle, a radius of 42.60 m is achieved, while it was only 40 m in the "Green Book".

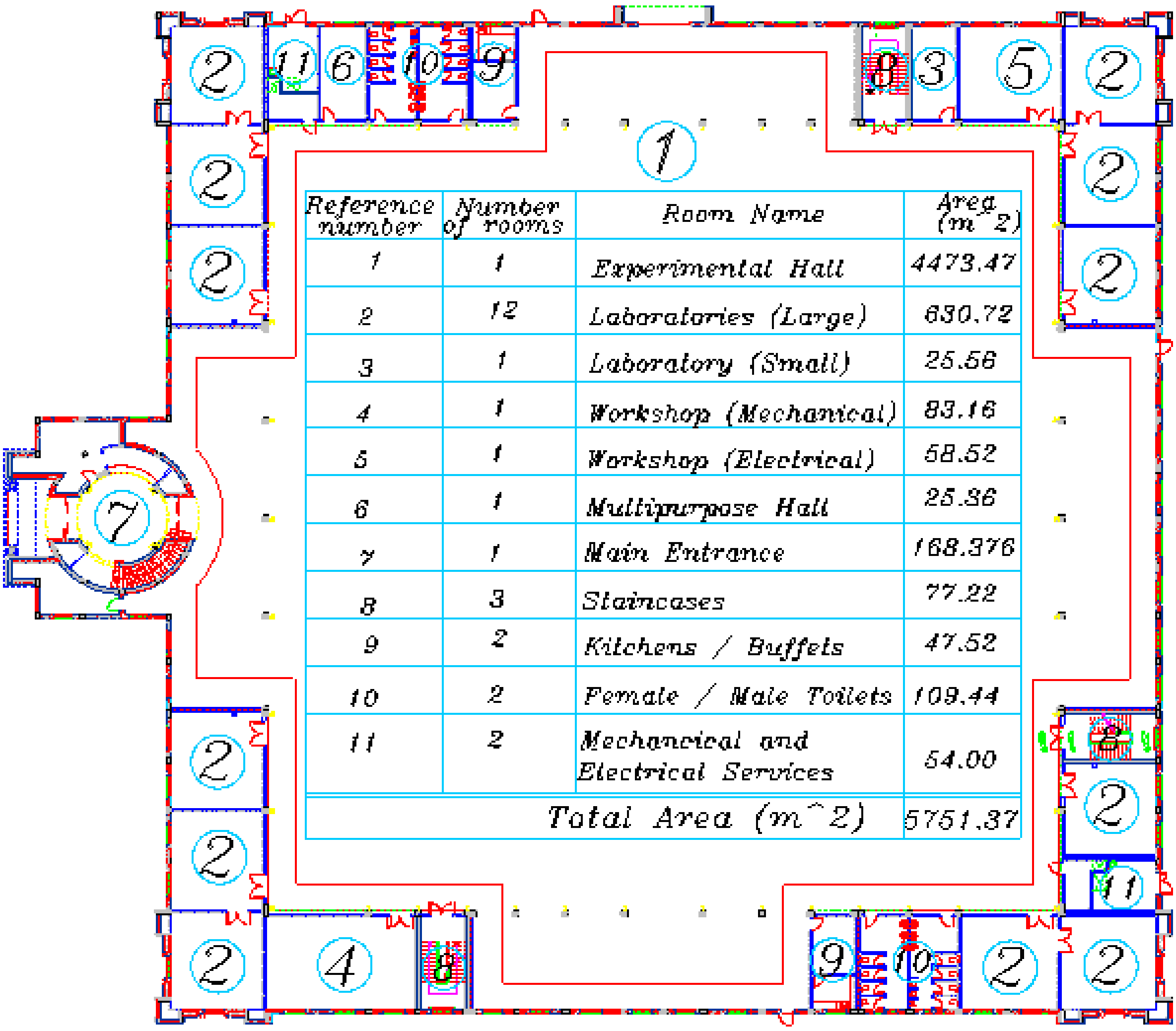


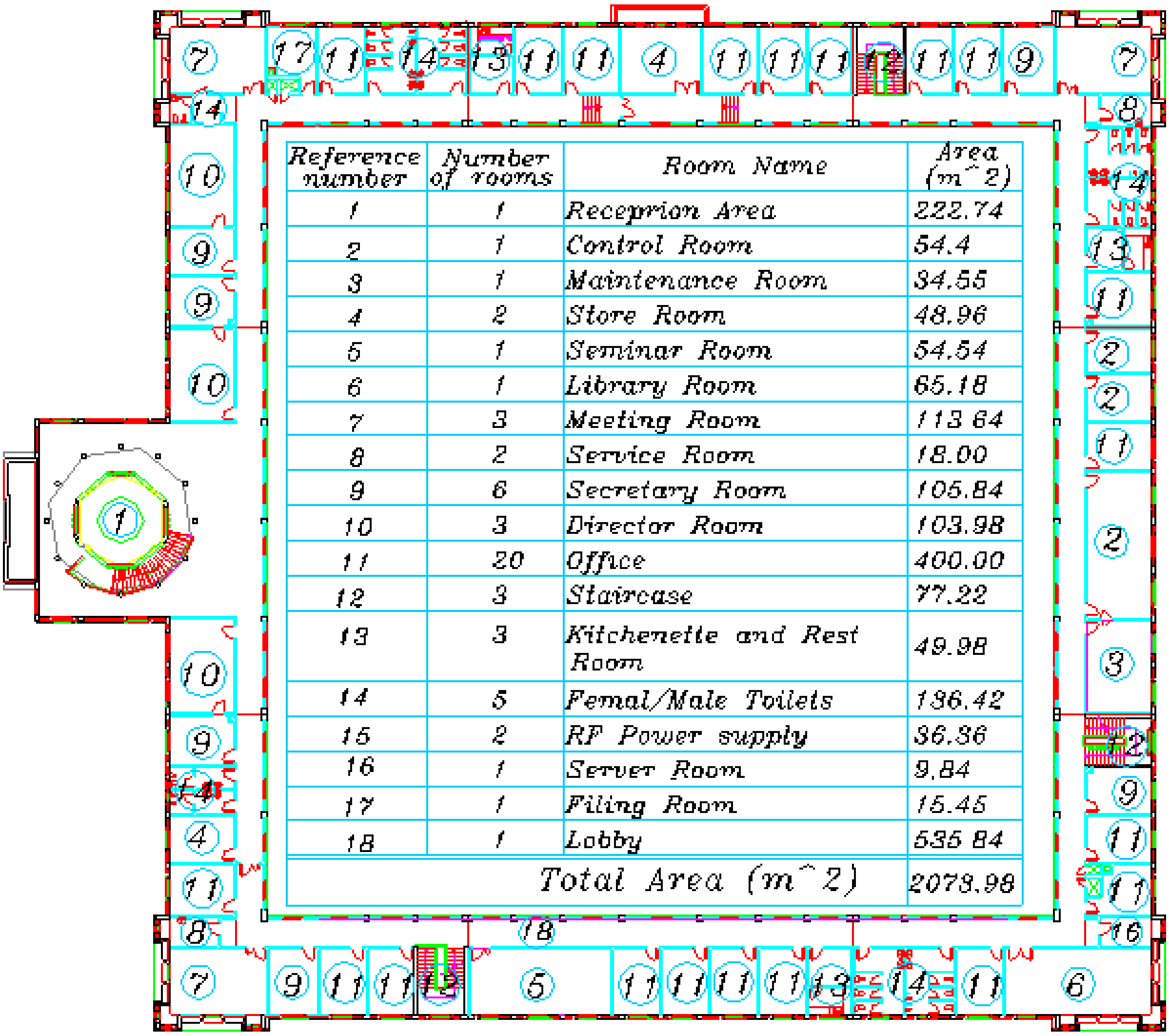
Figure 13.10: The ground floor of SESAME building with the experimental hall and the laboratories and workshops around it.

Table 13.1: Rooms, workshops, and laboratories on the ground floor.

Description	**Number**	**Area [m²]**	**Total Area [m²]**
Experimental Hall			
Rectangular area	1	3644.53m²	4473.47m²
Cut outs	4	828.94m²	
Physical Laboratories	8	52.56m²	420.48m²
Chemical Laboratories	4	52.56 m²	210.24 m²
Laboratory	1	25.56 m²	25.56 m²
Mechanical Workshop	1	83.16 m²	83.16m²
Electrical Workshop	1	56.52m²	56.52m²
Multipurpose hall	1	25.38 m²	25.38 m²
Main Entrance	1	168.376m²	168.376m²
Boiler rooms	2	18.00m²	36.00 m²
Electrical rooms	2	9.00m²	18.00m²
Kitchens/ buffets	2	23.76m²	47.52m²
Female / male toilets	2	54.72m²	109.44m²
Staircase	3	25.74m²	77.22m²
		GRAND TOTAL	**5751.37 m²**

The ground Floor area of the building is 5704 m^2 including the 4473 m^2 of the experimental hall area. Converting this area of the experimental hall to a circle, a radius of 42.60 m is achieved, while it was only 40 m in the "Green Book".

The layout of the first floor is shown in figure (13.11) with the administration area including 3 director offices, 1 meeting room and 3 secretary offices. The first floor also includes 20 staff offices, 3 buffets, 3 service rooms, 1 store room 1 maintenance room, 1 seminar room, 2 meeting rooms, and 1 library (see figure (13.11)). Detailed distribution of areas is given in tables (13.2), (13.3), (13.4), and (13.5). The first floor is supplied with a gangway with an access to the inner side of the storage ring (see figure (13.12)). This gangway will also be used for the supply of the needed infrastructure (electricity, cooling, etc.) to the inner side of the storage ring.



Reference number	Number of rooms	Room Name	Area (m^2)
1	1	Receprion Area	222.74
2	1	Control Room	54.4
3	1	Maintenance Room	34.55
4	2	Store Room	48.96
5	1	Seminar Room	54.54
6	1	Library Room	65.18
7	3	Meeting Room	113 64
8	2	Service Room	18.00
9	6	Secretary Room	105.84
10	3	Director Room	103.98
11	20	Office	400.00
12	3	Staircase	77.22
13	3	Kitchenette and Rest Room	49.98
14	5	Femal/Male Toilets	136.42
15	2	RF Power supply	36.36
16	1	Server Room	9.84
17	1	Filing Room	15.45
18	1	Lobby	535 84
		Total Area (m^2)	2073.98

Figure 13.11: The first floor of SESAME building with the offices, meeting rooms, control room and library.

Table 13.2: Rooms in the office right area of the first floor.

Description	Number	Area [m^2]	Total Area [m^2]
Seminar room	1	54.54m^2	54.54m^2
Meeting room	1	37.88 m^2	37.88 m^2
Secretary	1	17.64m^2	17.64m^2
Offices	8	18.18m^2	145.44m^2
Service room	1	9.00 m^2	9.00 m^2
Kitchenette & rest room	1	16.66 m^2	16.66 m^2
Female / male toilets	1	38.38 m^2	38.38m^2
Staircase	1	25.74 m^2	25.74m^2
		GRAND TOTAL	**345.28m^2**

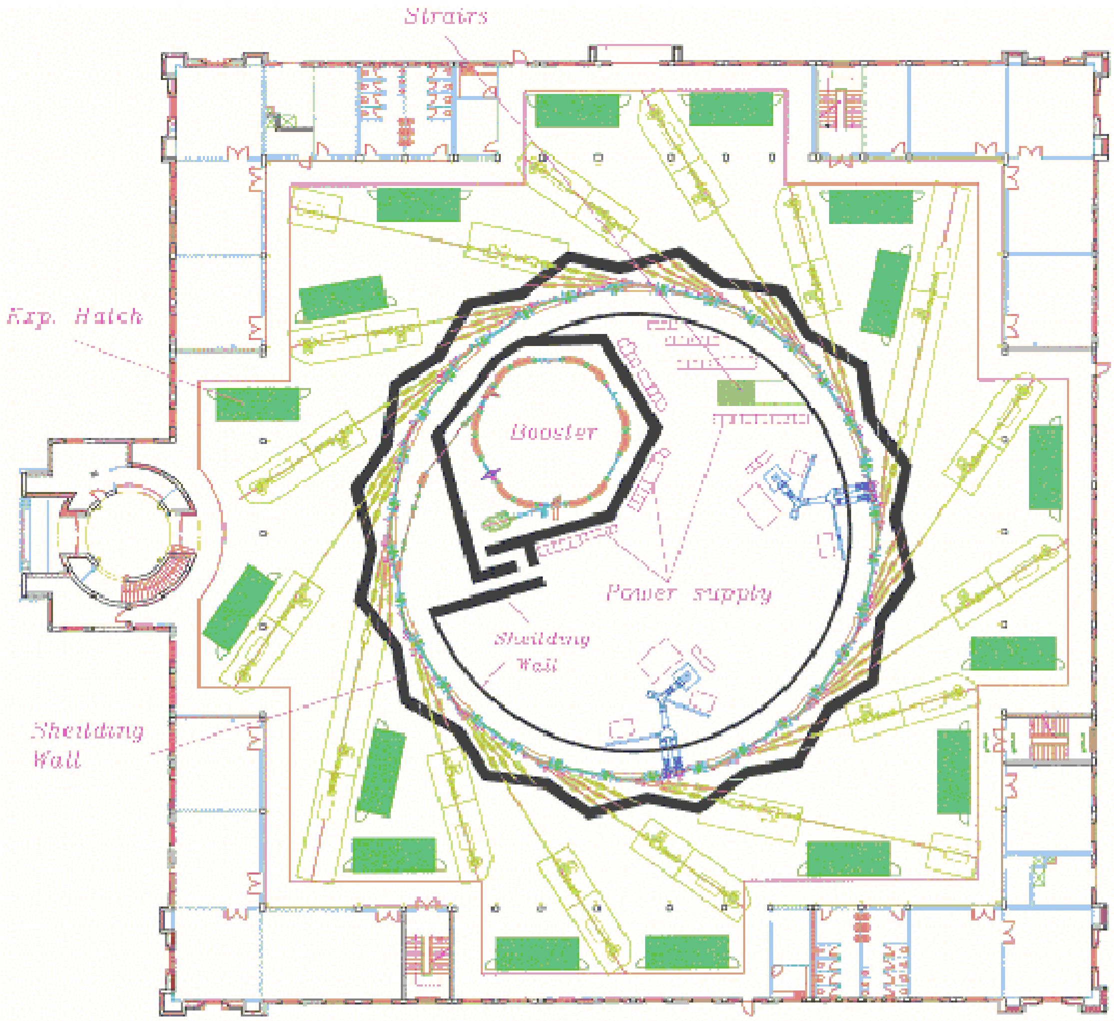


Figure 13.12: The ground floor of SESAME building with the storage ring, the shielding wall and the beam lines.

Table 13.3: Rooms in the control area of the first floor.

Description	Number	Area [m^2]	Total Area [m^2]
Control room	1	54.40m^2	54.40m^2
Maintenance room	1	34.55 m^2	34.55 m^2
Library	1	56.18m^2	56.18m^2
Offices	4	18.18 m^2	109.08m^2
R.F. power supply	2	18.18 m^2	36.36 m^2
Secretary	1	17.64 m^2	17.64 m^2
Service room	1	9.00m^2	9.00m^2
Kitchenette & rest room	1	16.66 m^2	16.66m^2
Female / male toilets	1	38.38 m^2	38.38 m^2
Server room	1	9.84m^2	9.84 m^2
Staircase	1	25.74m^2	25.74 m^2
		GRAND TOTAL	**407.83 m^2**

Table 13.4: Rooms in the administration area of the first floor.

Description	Number	Area [m^2]	Total Area [m^2]
Rectangular area	1	222.74m^2	222.74m^2
Director	3	34.66 m^2	103.98 m^2
Secretary	3	17.64m^2	52.92m^2
Meeting room	1	37.88 m^2	37.88m^2
Store room	1	17.65 m^2	17.65 m^2
Filing room	1	15.45 m^2	15.45 m^2
Kitchenette & rest room	1	16.66 m^2	16.66m^2
Female/male toilets	1	38.38 m^2	38.38m^2
Female/male toilets	1	17.63 m^2	17.63 m^2
Single toilet	1	203.65m^2	3.65 m^2
Offices	3	18.18m^2	54.54 m^2
		GRAND TOTAL	**581.48 m2**

Table 13.5: Rooms in the office left area of the first floor.

Description	Number	Area [m^2]	Total Area [m^2]
Maintenance room	1	37.88m^2	37.88m^2
Offices	5	18.18m^2	90.9 m^2
Secretary	1	17.64m^2	17.64m^2
Storage	1	31.31 m^2	31.31m^2
Staircase	1	25.74 m^2	25.74m^2
		GRAND TOTAL	**203.47 m^2**

Figures (13.13), (13.14), (13.15), and (13.16) display 3D drawings of SESAME building including its landscape and inner side of main entrance.

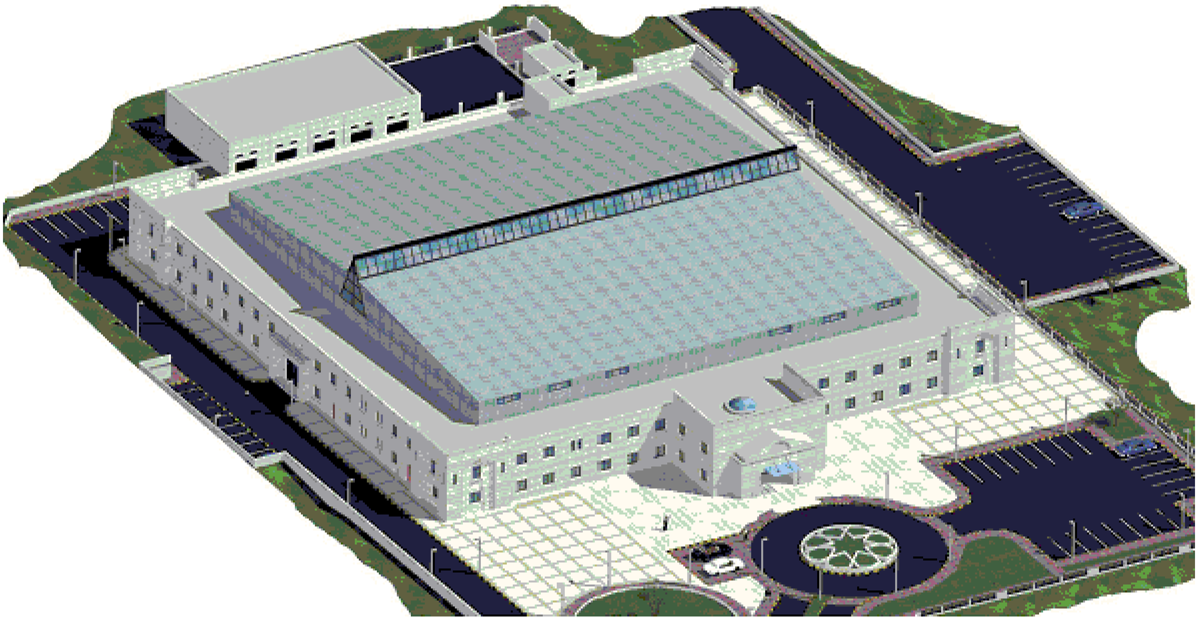


Figure 13.13: 3D-picture of the SESAME building with the main entrance in the front and the technical building in the back side.

Figure 13.14: 3D-picture of the SESAME building with the main gate and the main entrance.

Figure 13.15: 3D-picture of the SESAME building with the main gate and the parking place in front of it.

Figure 13.16: 3D-picture of the SESAME entrance hall with the reception booth and the staircase to the first floor.

13.5 Infrastructure

A comprehensive infrastructure is required for SESAME complex in order to be able to run the facility with the accelerator as well as the beam lines, and for the preparation and conductance of the experiments. Table (13.6) shows the mechanical infrastructure including water, gas, and drainage required for the laboratories and workshops of the ground floor. Table (13.7) shows the electrical infrastructure including voltages, phases, and sockets required for the laboratories and workshops of the ground floor.

Table 13.6: The mechanical infrastructure (water, gas, etc) for the laboratories and workshops of the ground floor.

INFRASTRUCTURE FOR THE GROUNDFLOUR MECHANICS

Room	Cooronates	Description	Pr-Air	Wa+Dr	Ch-Ou	Ch-Ex	Da-Sh	Ai-Ex	Dr-N	He
Experimental Hall			No	Wa:Yes Dr:No				No	No	No
Physics Laboratory	K-J/ 11-12	Microscopy	No	Yes			No			
Physics Laboratory	I-H/ 11-12		No	Yes				No	No	
Chemical Laboratory	H-G/ 11-12		No	Yes	Yes	Yes		Yes		
Chemical Laboratory	C-B / 11-12	Clean Room	No	Yes	Yes	Yes		Yes		
Physics Laboratory	B-A/ 11-12	Sample Prepare.	No	Yes				No	No	
Physics Laboratory	L-M/ 11–12	UHV Vac-Labor.	No	Yes						
Mechanical Workshop	L-M/ 8.5-10	Machine Shop	No	Yes						
Staircase	L-M/ 8.5-8		No	Yes						
Buffet	L-M/ 4.5-4´									
W.C. (Female)	L-M/ 4-3.5									
W.C. (Male)	L-M/ 3.5-3									
Physics Laboratory	L-M/ 3-2									
Physics Laboratory	L-M/ 1-0		No	Yes					No	
Boiler Room	A-A5/ 1-0	Optical Labor.	No	Yes			No	No	No	
Chemical Laboratory	A.5-B.5/ 1-0							Yes		
Staircase	B.5-C/ 1-0		No	Yes	Yes	Yes				
Chemical Laboratory	G-H/ 1-0									
Physics Laboratory	I-H/ 1-0	Protein Chemistry	No	Yes	Yes	Yes		Yes		
Physics Laboratory	J-K/ 1-0	Cold Room	No	Yes						
Electrical Workshop	J-K/ 2-3	Molecular Biology	No	Yes						
LAB.	J-K/ 3-3.5	Electronic Shop	No	Yes						
Staircase	J-K/ 3. 5-4		No	Yes						
Buffet	J-K/ 7.5-7´									
W.C. (Female)	J-K/ 8-8.5									
W.C. (Male)	J-K/ 8.5 -9									
Multi purpose hall	J-K/ 9-9.5									
Boiler Room	J-K/ 9.5-10									

Pr-Air. Pressure Air, Wa+Dr. Water and draining, Oh-Ou. Chemical Outlet, Ch-Ex: Chem
Da-Sh: Darkening Shutters, Ai-Ex: Exhaust, Dr-N: Dry Nitrogen, He: Helium

For the beam lines we have the following utilities:
Cooling water, cooling water for HVAC, dry nitrogen, pressure air, helium, exhaust system

Table 13.7: The electrical infrastructure (sockets, lan, etc) for the laboratories and workshops of the ground floor

INFRASTRUCTURE FOR THE GROUNDFLOUR

ELECTRICITY

Room	Cooronates	Description	B – D	So-Li	So	Lo-Ne	Cl-Ne
Experimental Hall			12 times				
Physics Laboratory	K-J/ 11-12	Microscopy	1 times	8 times		Yes	Yes
Physics Laboratory	I-H/ 11-12		1 times	8 times		Yes	Yes
Chemical Laboratory	H-G/ 11-12		1 times	8 times		Yes	
Chemical Laboratory	C-B / 11-12	Clean Room	1 times	8 times		Yes	
Physics Laboratory	B-A/ 11-12	Sample Prepar.	1 times	8 times		Yes	Yes
Physics Laboratory	L-M/ 11–12	UHV Vac-Labor.	2 times	8 times		Yes	Yes
Mechanical Workshop	L-M/ 8.5-10	Machine Shop	4 times	8 times		Yes	
Staircase	L-M/ 8.5-8				Yes		
Buffet	L-M/ 4.5-4´				Yes		
W.C. (Female)	L-M/ 4-3.5				Yes		
W.C. (Male)	L-M/ 3.5-3				Yes		
Physics Laboratory	L-M/ 3-2		1 times	8 times		Yes	Yes
Physics Laboratory	L-M/ 1-0		1 times	8 times		Yes	Yes
Boiler Room	A-A5/ 1-0	Optical Labor.			Yes		
Chemical Laboratory	A.5-B.5/ 1-0		1 times	8 times		Yes	
Staircase	B.5-C/ 1-0				Yes		
Chemical Laboratory	G-H/ 1-0		1 times	8 times		Yes	
Physics Laboratory	I-H/ 1-0	Protein Chemistry	1 times	8 times		Yes	Yes
Physics Laboratory	J-K/ 1-0	Cold Room	1 times	8 times		Yes	Yes
Electrical Workshop	J-K/ 2-3	Molecular Biology	2 times	8 times		Yes	Yes
LAB.	J-K/ 3-3.5	Electronic Shop	1 times	4 times		Yes	Yes
Staircase	J-K/ 3. 5-4				Yes		
Buffet	J-K/ 7.5-7´				Yes		
W.C. (Female)	J-K/ 8-8.5				Yes		
W.C. (Male)	J-K/ 8.5 -9				Yes		
Multi purpose hall	J-K/ 9-9.5				Yes		
Boiler Room	J-K/ 9.5-10				Yes		

B-D: Electricity Di ystributor with 3 times 220V, 16A; 1 times 380V, 16A; 1 times 380V, 32A
So-Li: Socket points in Labs With sockets 220V, 16A
So: Socket (220 V. 16A), Lo – Ne: Local Area Network, Cl – Ne: Clean – net sockets

Table 13.8: Mechanical and electrical infrastructure for the room and offices of the first floor.

INFRASTRUCTOR FIRST FLOOR
Mechanic and Electricity

Cooronates	**Description**	**Water and draining**	**Local area network**	**Sockets 220 volt**	**Sockets "clean net"**
K-J.25/ 11.25-12	Meeting Room		Yes	4 times	
J.25-J/11.25-12	W.C.	Yes			
I-H/ 11.25-12	Director Room		Yes	4 times	
H-H.5/ 11.25-12	Secretary Room		Yes	3 times	
H.5-G/ 11.25-12	Secretary Room		Yes	3 times	
´G-F / 11.25-12	Director Room		Yes	4 times	
F – D / 11.25-12	Entrance			4 times	
D-C̄ / 11.25-12	Director Room		Yes	4 times	
C – C.5 / 11.25- 12	Secretary Room		Yes	3 times	
C.5-C. 75 / 11.25-12	W.C. (Female)	Yes		1 time	
C.75-B / 11.25-12	W.C. (Male)	Yes		1 time	
B-B.5 / 11.25-12	Store Room	Yes		2 times	
B. 5-A / 11.25-12	Office		Yes	4 times	
L.25-M / 12.75-11	Service Room		Yes	2 times	
L-M / 11.25-12	Meeting Room		Yes	4 times	
L.25-M / 12.75-11	Secretary Room		Yes	3 times	
L.25-M /9.5-9	Office		Yes	4 times	
L.25-M / 9-8.5	Office		Yes	4 times	
L.25-M / 8.5-8	Staircase			1 time	
L.25-M / 7-7.75	Seminar Room		Yes	7 times	
L.25-M / 7.75-6.5	Office		Yes	4 times	
L.25-M / 6.5-5.25	Office		Yes	4 times	
L.25-M /5.25-5	Office		Yes	4 times	
L.25-M / 5-5.5	Office		Yes	4 times	
L.25.M / 5.5-4	Buffet	Yes	Yes	3 times	
L.25-M / 4-3.5	W.C. (Female)	Yes		1 time	
L.25- M / 3.5-3	W.C. (Male)	Yes		1 time	
L.25-M / 3-2.5	Office		Yes	4 times	
A-B.5 / 2.5-0	Library		Yes	8 times	
0-0.75/L-L.25	Server room		Yes	2 times	
0.0.75/A-A.5	Office		Yes	4 times	
0-0.75/A.5-B	Office		Yes	4 times	
0-0.75/B-C.5	Secretary		Yes	3 times	
0-0.75/C.5-C	Staircase		Yes	1 time	
0-0.75/C-D	Maintenance room		Yes	10 times	6 times
0-0.75/D-E-5	Control room		Yes	12 times	8 times
0-0.75/E.5-F	Office		Yes	4 times	
0-0.75/F-F.5	R.F Power supply room2		Yes	8 times	
0-0.75/F.5-G	R.F Power supply room1		Yes	8 times	
0-0.75/G-G.5	Office		Yes	4 times	
0-0.75/G.5-H	Buffet	Yes	Yes	3 times	
0-0.75/H-H.5	W.C. (Female)	Yes		1 time	
0-0.75/H.5-I	W.C. (Male)	Yes		1 time	

Table 13.8: Mechanical and electrical infrastructure for the room and offices of the first floor.

Cooronates	Description	Water and draining	Local Area Network	Sockets 220 Volt	Sockets "clean net"
0-0.75/J-J.25	Service			1 time	
1-0/J.25-K	Meeting Room		Yes	4 times	
2-2.5/J.25-K	Secretary room		Yes	4 times	
2.5-3/J.25-K	Office		Yes	1 time	
3-3.5/J.25-K	Office		Yes	4 times	
3.5-4/J.25-K	Staircase			1 time	
4-4.5/J.25-K	Office		Yes	4 times	
4.5-5/J.25-K	Office		Yes	4 times	
5-5/J.25-K	Office		Yes	4 times	
5-6/J.25-K	Store			5 times	
6-7/J.25-K	Office		Yes	4 times	
7-7.5/J.25-K	Office		Yes	4 times	
7.5-7/J.25-K	Buffet	Yes	Yes	3 times	
8-8.5/J.25-K	W.C. (Female)	Yes		1 time	
8.5-9/J.25-K	W.C. (Male)	Yes		1 time	
9-9.5/J.25-K	Office		Yes	4 times	
9.5-10/J.25-K	Filling room		Yes	4 times	

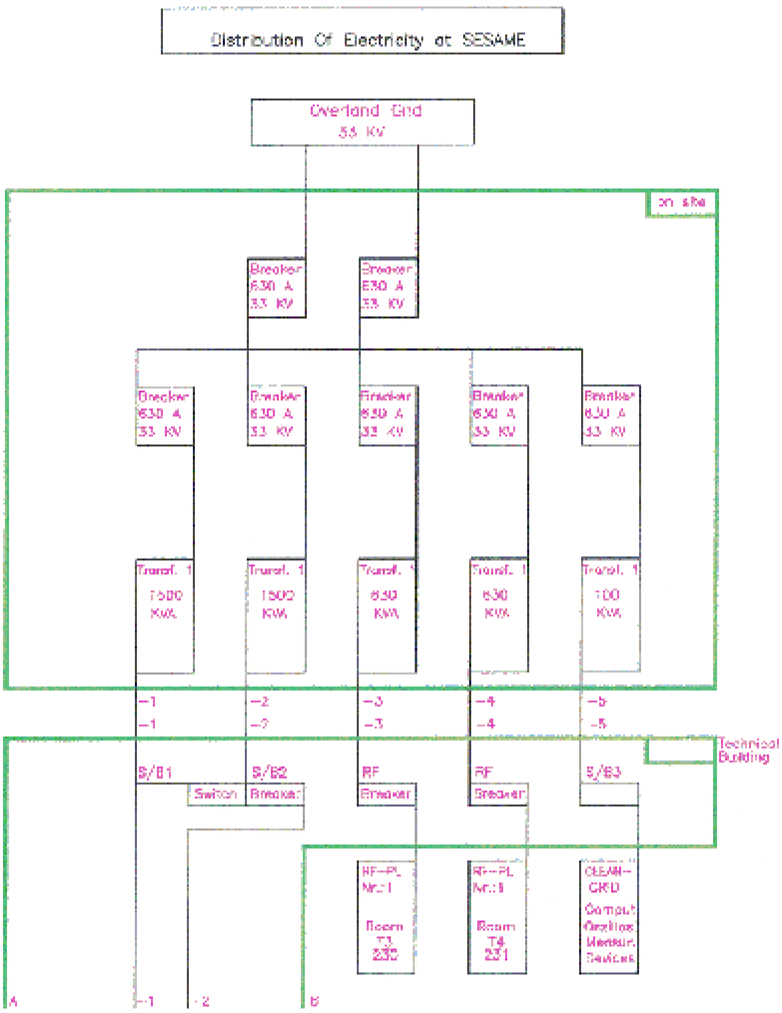


Table 13.9 (Part 1): Distribution of the electricity for the operation of the synchrotron light source SESAME.

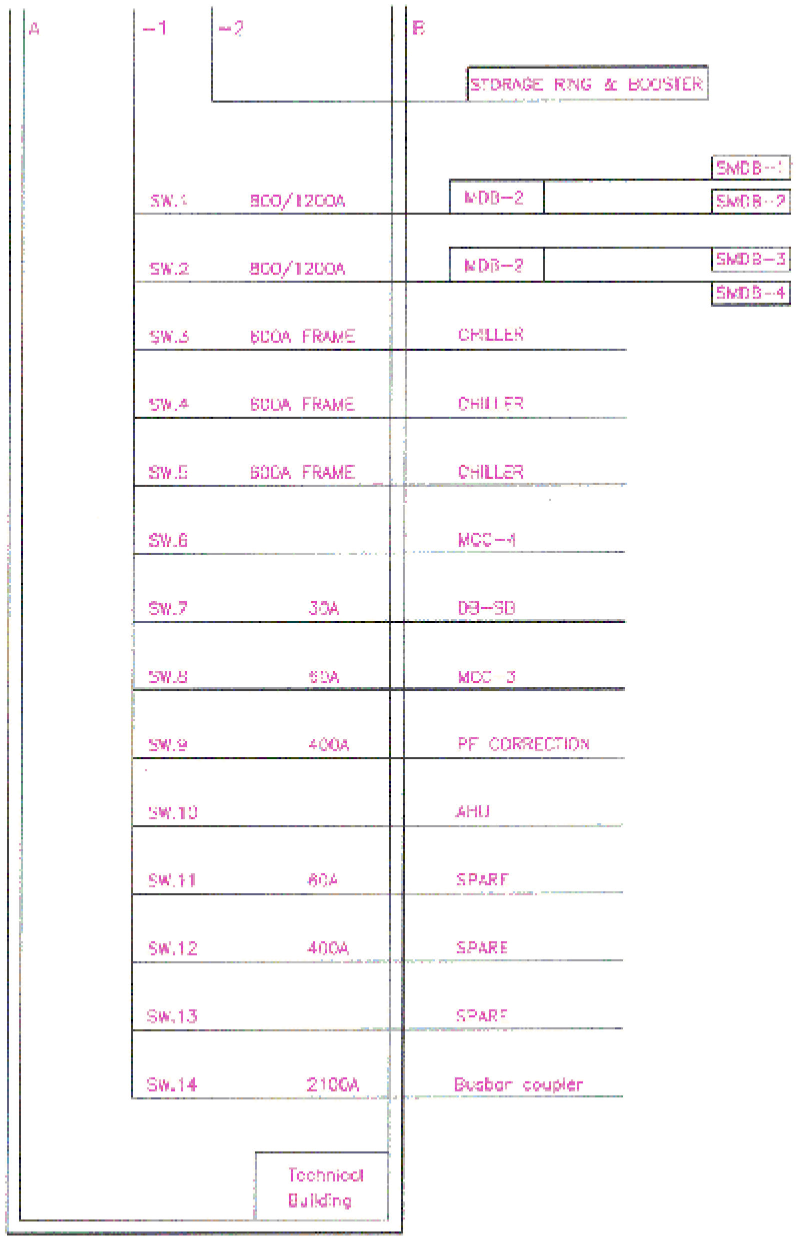


Table 13.9. (Part 2): Distribution of the electricity for the operation of the synchrotron light source SESAME.

Table 13.10: explanation of the brakers and switches used in table (13.9)

SWITCHES AND ELECTRICAL SISTRIBUTION

Name	Distr-ibutor		Power	Voltage (V)	Curr-ent (A)	Comments
Q 1	EV 11	UV 08/09	1.725 MVA	400	2500	This is the current layer to the inner side of the ring
Q 2	EV 11		276 KVA	400	400	Primaerkuehlung im Raum 2. 1.2
Q 3	EV 11		1.725 MVA	400	2500	Input from transformation Nr.:2,Output formfield 1-3
Q 4	EV 11		1.725 MVA	400	2500	Connection from field 4 to field 7 (bridging the trafos)
Q 5	EV 11		1.725 MVA	400	2500	Input from transformation Nr.: 1, Output for field 6-11
Q 6	EV 11		1.725 MVA	400	2500	Connection to the cooling building
Q 7	EV 11	UV 50	276 KVA	400	400	Distribution innerside of the ring (east direction)
Q 8	EV 11	UV 06	276 KVA	400	400	Distribution innerside of the ring (west direction)
Q 9	EV 11		276 KVA	400	400	Cos (phi) compensation unit
F 21	EV 11	UV 46	86 KVA	400	125	Distribution for the beamlines (east direction) UV 46
F 22	EV 11	UV 45	86 KVA	400	125	Distribution for the beamlines (west direction) UV 45
F 23	EV 11	UV 01	69 KVA	400	100	Socket distribution (for new installations) UV 19/UV 18
F 24	EV 11	UV 02	69 KVA	400	100	As F 23, 4*16A (2 phases), 2*16A (3 phases). 1*32A (3 phases).
F 25	EV 11	UV 03	69 KVA	400	100	As F 23, 4*16A (2 phases), 2*16A (3 phases). 1*32A (3 phases)
F 26	EV 11	UV 04	69 KVA	400	100	As F 23, 4*16A (2 phases), 2* 16A (3 phases). 1*32A (3 phases)
F 27	EV 11	UV 23	69 KVA	400	100	As F 23, Electricity for very fast actions. Basic supply for the hall.
F 28	EV 11	UV 10	69 KVA	400	100	As F 23 Supply for the chemical laboratory
F 29	EV 11	UV 11	43 KVA	400	63	Socket distribution for the cooling room
F 31	EV 11	UV 12	43 KVA	400	63	Socket distribution for utilities (heating room)
F 32	EV 12	UV 01	110 KVA	400	160	Distribution for the control room
F 34	EV 11		14 KVA	400	35	Electricity for the crane
F 36	EV 30	UV 02	4 KVA	110	35	Connection to the puffer battery (110 V)
F 37	EV 11	UV 28	43 KVA	400	63	Socket distribution in the "Low Voltage Room"
F 38	EV 12	UV 02	69 KVA	400	100	Additional distribution for the inner side of the ring
F 39	EV 11	UV 30	43 KVA	400	63	Socket distribution for the "Medium Voltage Room"
F 40	EV 30	UV 01	14 KVA	400	35	Security lighting
F 41	EV 11	UV-Heat.	14 KVA	400	35	Socket distribution for the heating room
F 42	EV 12	UV-Chem	14 KVA	400	35	Electricity for the chemical exhaust
F 52	EV 11	UV 32/33	86 KVA	400	125	Distribution for the "Low Voltage Room"

13.4 Cooling System

For the operation of the accelerators as well as the beam lines a cooling system is needed. Overall an electricity power of roughly 3 MW is installed and this has to be cooled down. In the following subsection the first layout of the cooling system will be discussed. The principle of a cooling scheme is presented in figure (13.17) and figure (13.18). It exists of the chiller system (D), the pumping station (B) and the air conditioning (C). Over the pumping station B the cooled water will be pumped through the different elements (magnets, cavity, klystron etc) and will cool them down. Normally the entrance temperature for the elements will be 19 degrees and the outlet will be 34 degrees. The air conditioning, which has to temper the experimental hall, must be cooled by the chiller system too.

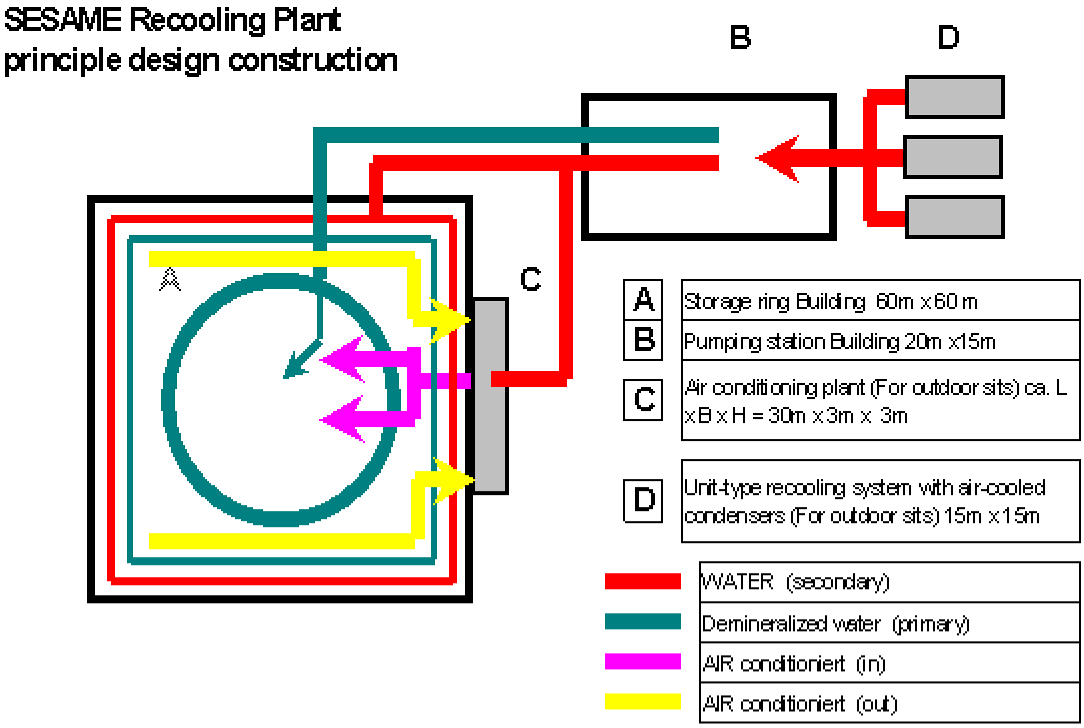


Figure 13.17: The components of the cooling system for the accelerator as well as the experimental hall of SESAME.

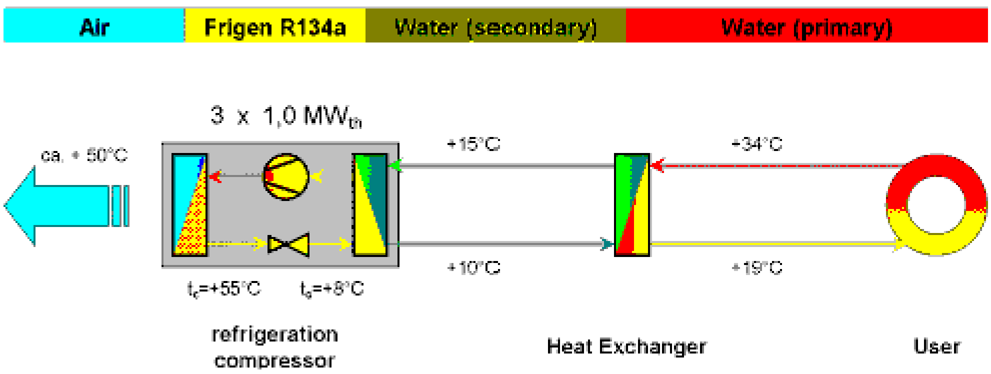


Figure 13.18: The principle layout of the cooling system for the accelerator as well as the experimental hall of SESAME.

The main component of the cooling plant is the compressor that produces at one side a temperature of 9 degree and at the other side of 46 degree. This is done by a special medium (Frigen) and by different pressures. At each end of the compressor there is a heat exchanger.

The colder side of the compressor is connected via the secondary cooling loop, another heat exchanger, and the primary cooling loop with the loads (magnets, power supplies, absorbers etc.). The medium for the secondary cooling loop is water and that on of the primary loop is demineralised water. The warmer side of the compressor is connected over a water loop with the cooling tower. As an example, the compressor from ANKA is shown in figure (13.19) and the cooling tower in figure (13.20). The specific layout of the cooling system is given by the power, which has to be cooled and the environmental condition at the building site.

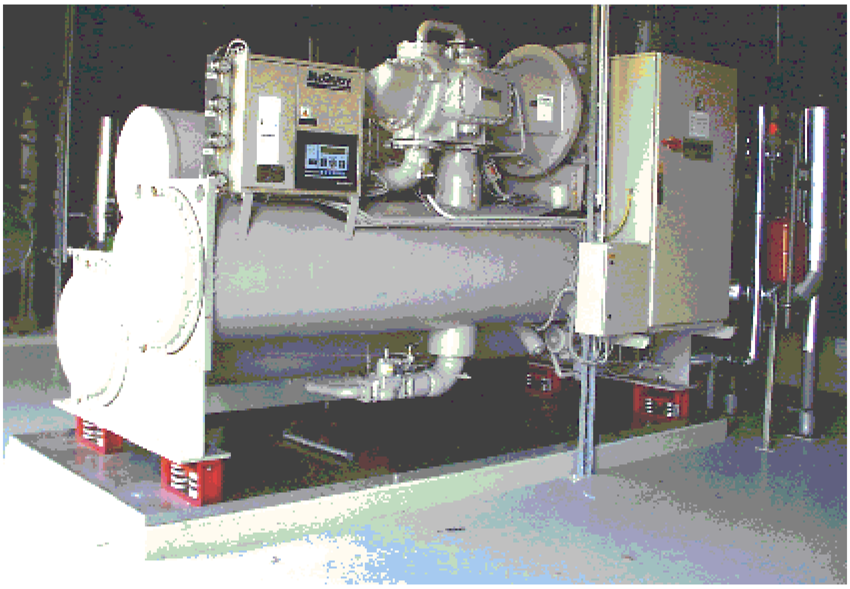


Figure 13.19: A picture of the 1 WM - compressor of the ANKA cooling plant.

Figure 13.20: A picture of the 6 cooling towers used for the ANKA cooling plant.

13.4.1 Capacity for the Cooling System

For the design of the system the consumption of the cooling load is required. The cooling loads are given by the magnets, the power supplies, the cavities, the beam lines, the building etc. In table (13.11) and (13.12), the consumption of the magnets of the accelerators, transfer lines, others and the RF-system for different stages are compiled. Table (13.13) gives the total needed power for the different stages. The first stage will be running SESAME with an energy of 2 GeV and have 4 wiggler beam lines installed. For this stage overall 2.3 MW have to be installed. The consumption for the building and the beam lines are taken over from ANKA, that one of the cooling compressors was given by the company.

Table 13.11: Power consumption of the magnets at SESAME in kW

Power Consumption of the SESAME Magnets							
Storage ring (2.5 GeV)							
Dipol		Quadrupole		Sextupole		Others	Total
Magnet	Po-Suppl.	Magnet	Po.-Suppl.	Magnet	Po.-Suppl	Po.-Suppl	Po.-Suppl.
361	406	66	75	48	54		535
Booster - Synchrotron (800MeV)							
Dipol		Quadrupole		Sextupole		Others	Total
Magnet	Po-Suppl.	Magnet	Po.-Suppl.	Magnet	Po.-Suppl	Po.-Suppl	Po.-Suppl.
90	100	7.5	8.5				975
Transfer : Booster - Storage Ring (800MeV)							
Dipol		Quadrupole		Sextupole		Others	Total
Magnet	Po-Suppl.	Magnet	Po.-Suppl.	Magnet	Po.-Suppl	Po.-Suppl	Po.-Suppl.
5	5.7	2.5	2.8				85
Microtron plusTransfer to Booster (22 MeV)							
Dipol		Quadrupole		Sextupole		Others	Total
Magnet	Po-Suppl.	Magnet	Po.-Suppl.	Magnet	Po.-Suppl	Po.-Suppl	Po.-Suppl.
5	5.7					5.7	114

Table 13.12: Power consumption of the RF-System at SESAME in kW.

Power Consumtion of the RF-System							
Case	Energy GeV	Current mA	Nu./Wigg	Cav.-Volt. kV	Nu./Cavit.	Klystr.-Po. kW	Total Po. kW
1	2	200	4	250	2	250	575
2	2.5	200	4	500	4	500	1150
3	2.5	400	6	750	6	750	1725

Table 13.13: Power Consumption at SESAME for different stages.

Total Power Consumption for SESAME								
Case	RF-Syst. kW	Stor.-Ring kW	Injector kW	Building kW	Others kW	Cooling kW	Beam Lin. kW	Total kW
1	575	304	140	150	120	1000	120	2289
2	1150	475	140	200	150	1300	120	3535
3	1725	475	140	200	180	1600	240	4560

Table 13.14: Total power to be cooled at SESAME.

Total Power to be cooled							
Case	RF-Syst. kW	Stor.-Ring kW	Injector kW	HVAC kW	Cooling kW	Beam Lin. kW	Total kW
1	575	304	140	700	1000	120	2839
2	1150	475	140	700	1300	120	3885
3	1725	475	140	700	1600	240	4640

The power to be cooled is given in table (13.14).
For the cooling system the following circuits are foresee:

- One for the booster and for the storage ring.
- One for the klystron and cavities.
- One for the beam lines.
- Two for the air handling units of the HVAC system.
- One for small air handling units in the hall.

For the first three cooling circuits it is foreseen to use 2 chiller's with a capacity of 1 MW each. For the cooling of the air handling units a chiller with a capacity of 1 MW is foreseen. The principle layout of the secondary and primary cooling circuits are presented in the figures (13.23) to (13.27). The ground floor of the Technical Building for housing the primary pumps, heat exchanger, secondary pumps, storage tanks, evaporation pumps are given in figure (13.21). The chillers are located outside adjacent to the technical building.

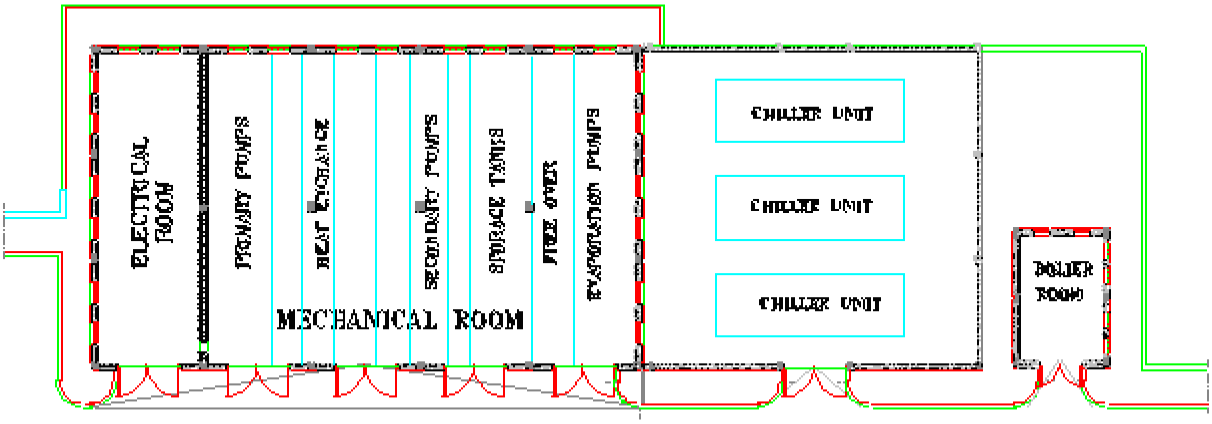


Figure 13.21: Ground floor of the Technical Building with the space for the need electrical and mechanical infrastructure.

Figure 13.22: The building of SESAME with the Technical Building for housing the infrastructure in the background

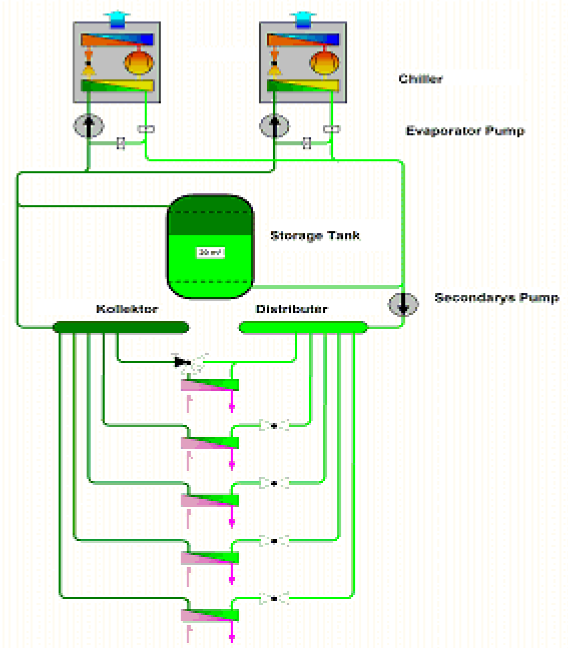


Figure 13.23: Overview of the secondary cooling scheme for the accelerators with the cooling circuits for the booster, storage ring magnets, RF-system, beam lines etc. Each chiller has a capacity of 1 MW. The secondary cooling circuit is running within the temperature range of 10 to 15 degrees. From the heat exchanger starts the primary cooling with circuits of 20 to 35 degrees.

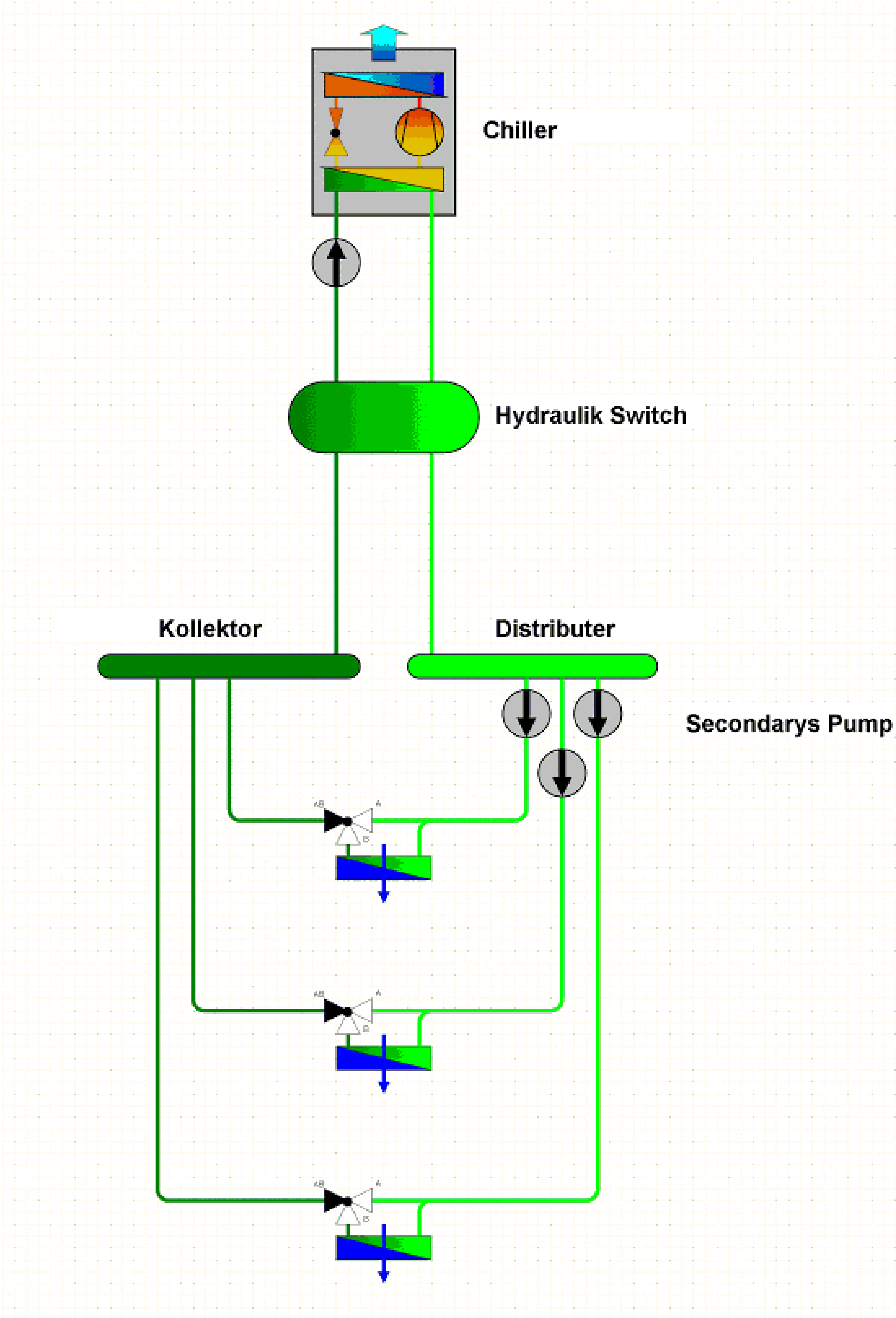


Figure 13.24:Overview of the secondary cooling circuit for the HVAC-system. The explanations are the same as in Figure (13.13). The three secondary circuits are for the 2 machines of the HVAC system and one for the beam lines.

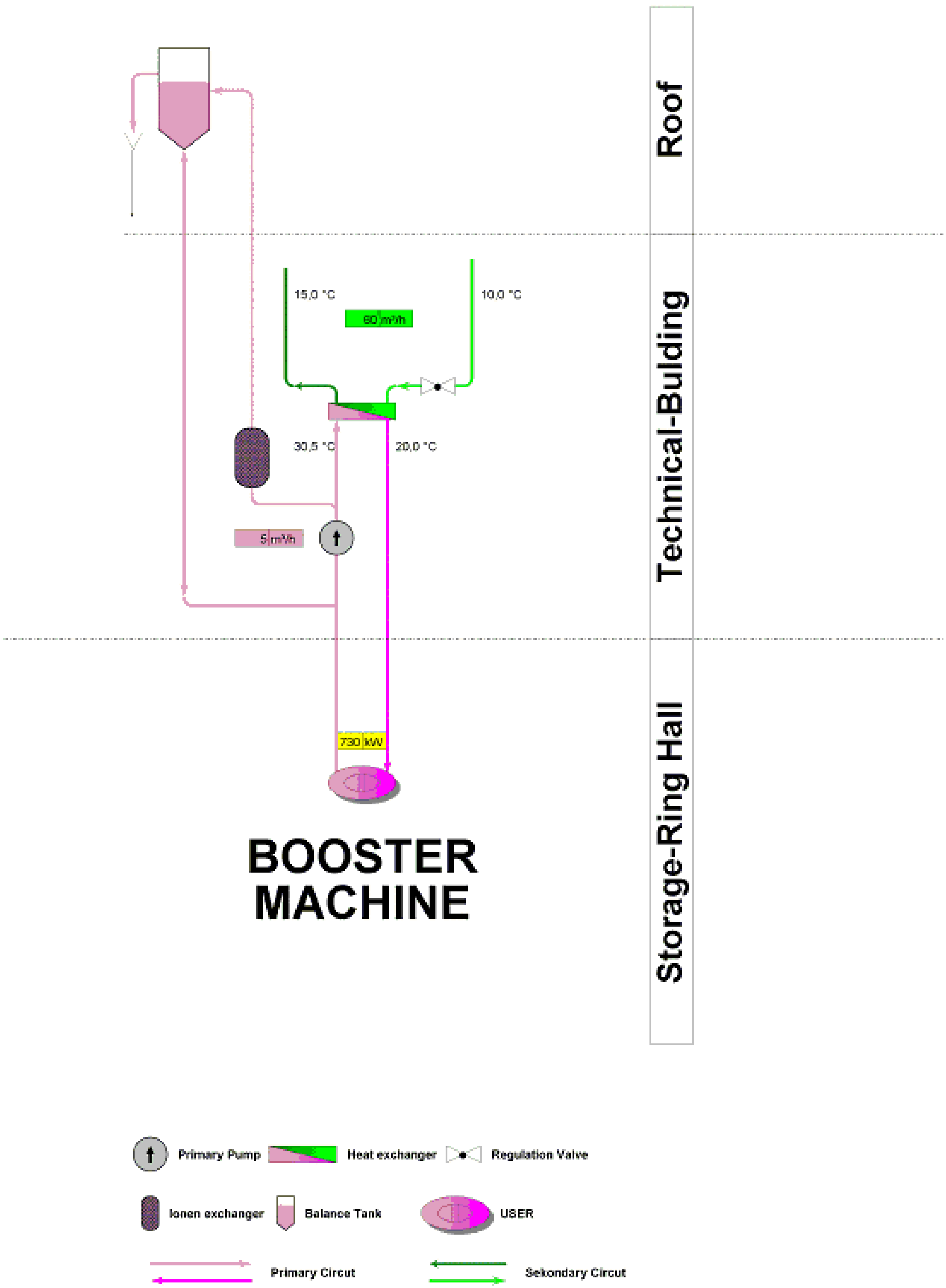


Figure 13.25: Primary circuit for the cooling of the booster and the magnets of the storage ring. The location of the extension tank must be on the roof of the experimental hall (see Figure (13.27))

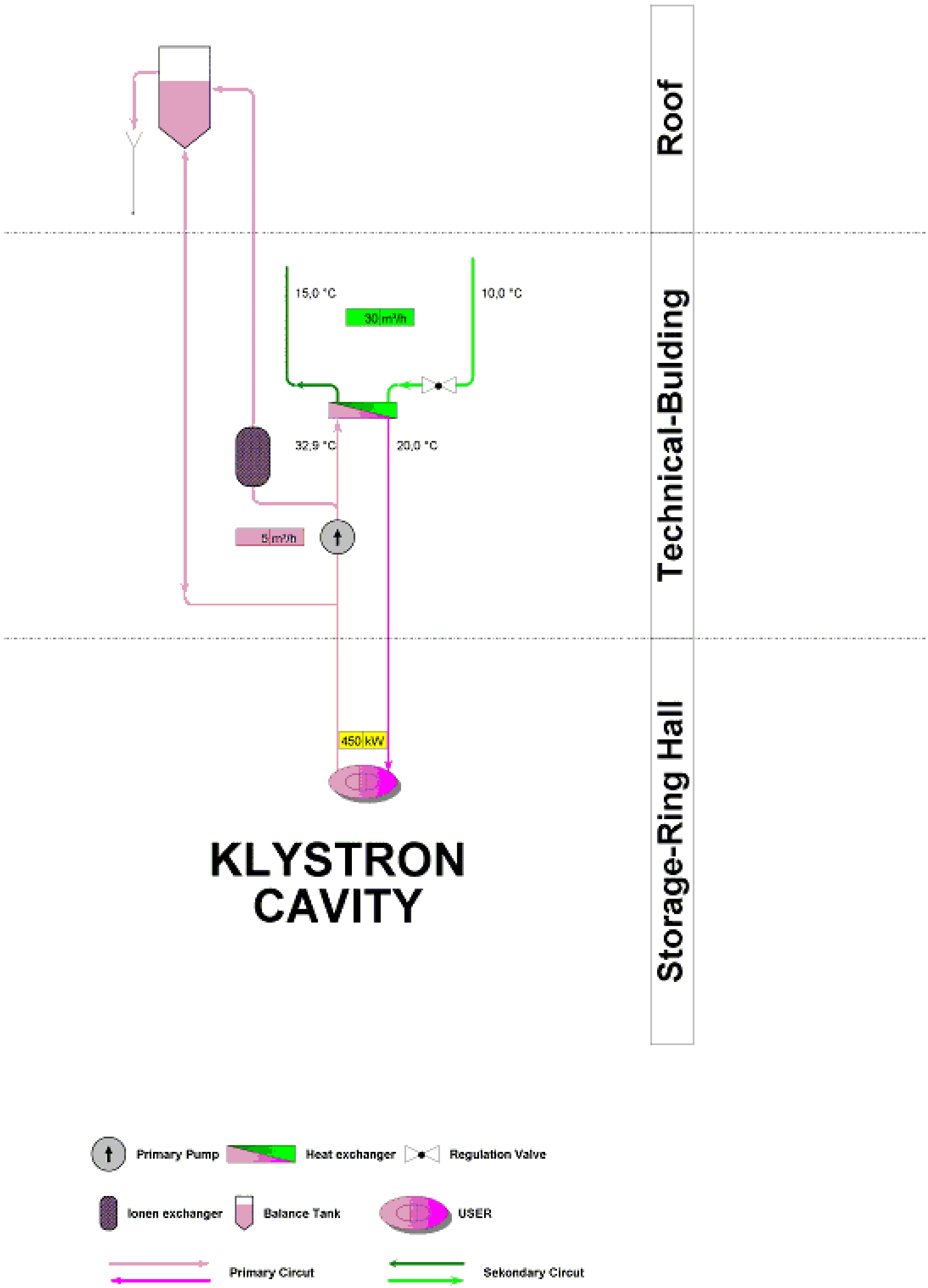


Figure 13.26: Primary circuit for the cooling of the klystron and the cavities of the storage ring. For the location of the different components see Figure (13.27).

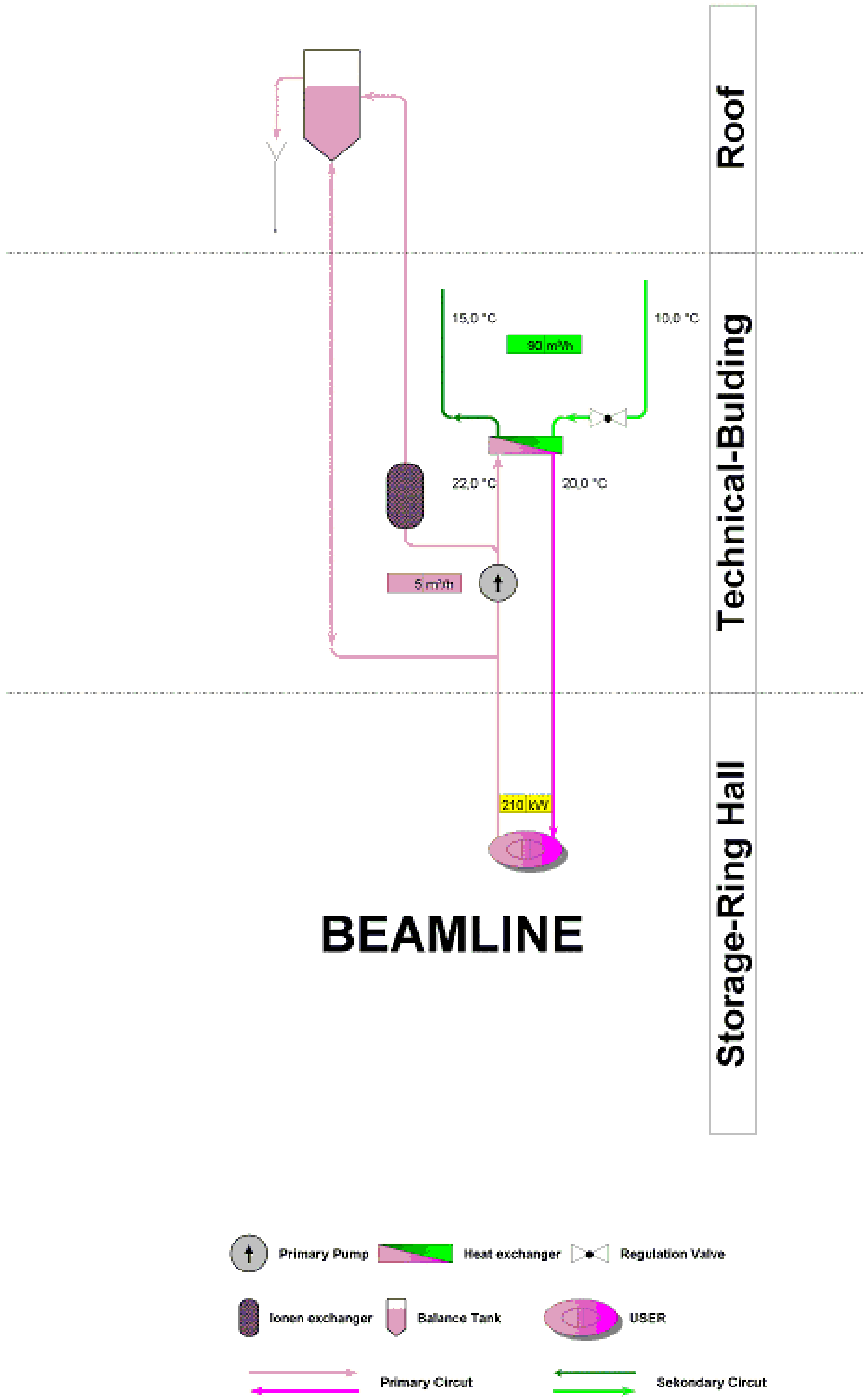


Figure 13.27: Primary circuit for the cooling of the beam lines. The location of the different components is given at the left of the figure .

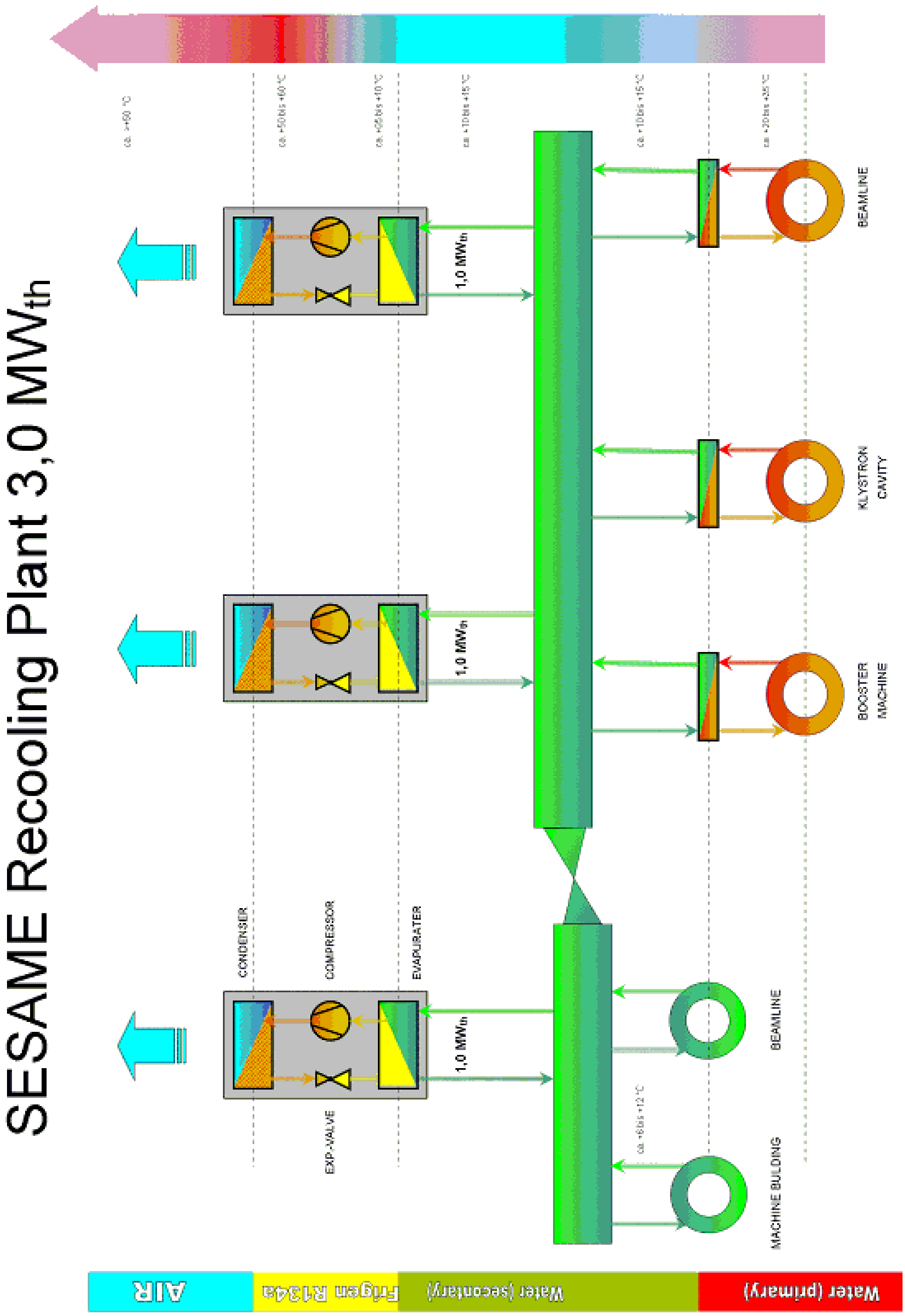


Figure 13.28: The principle layout of the cooling system for the accelerator as well as the experimental hall of SESAME.