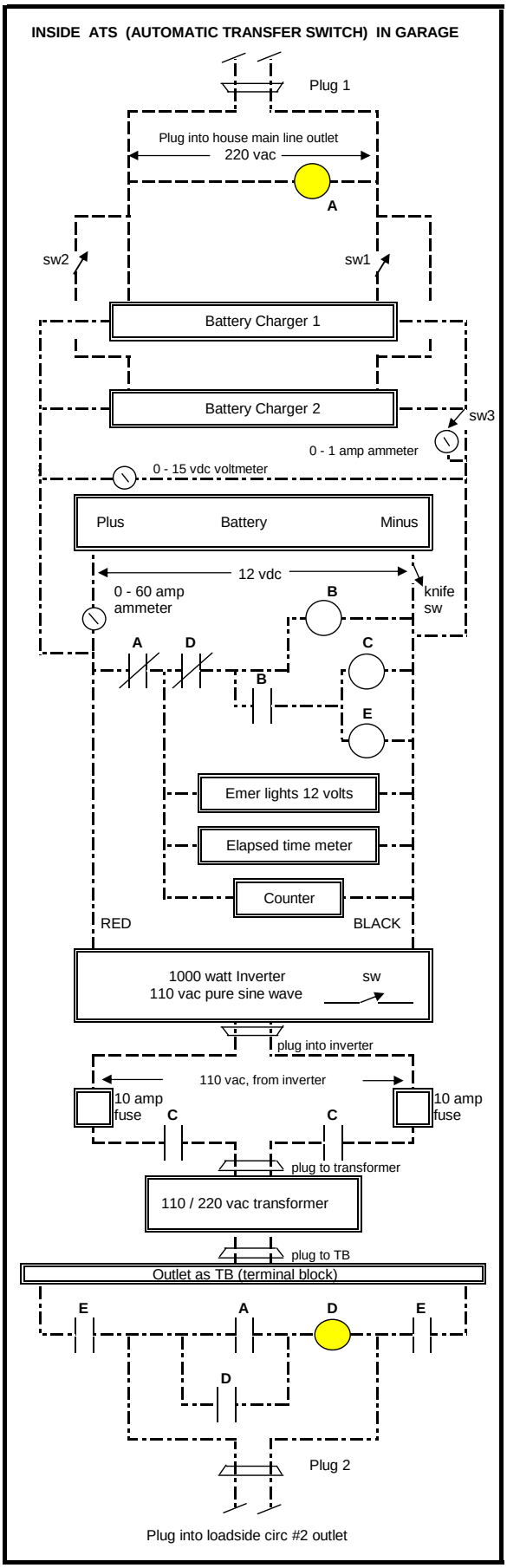


RATIONALE:

1. Brownouts occur frequently in the Municipality of Tanjay.
2. They last usually for a few minutes up to an hour or two.
3. There is on hand a 1250 watt generator, but it is 110 volts, so when used, it has to pass through a 110 to 220 vac transformer.
4. Running the generator is much of a hassle, with the noise, fuel and fumes, and manual start up and connections.
5. The project as detailed herein shows how an emergency electrical system was made to be fully automatic, using an inverter, heavy duty battery, and switching circuitry. Truly, an ATS, or Automatic Transfer Switch.

SEQUENCE OF OPERATION SHOWING VARIOUS SCENARIOS

AT A.T.S. IN GARAGE

Scenario 1: NORMAL MODE

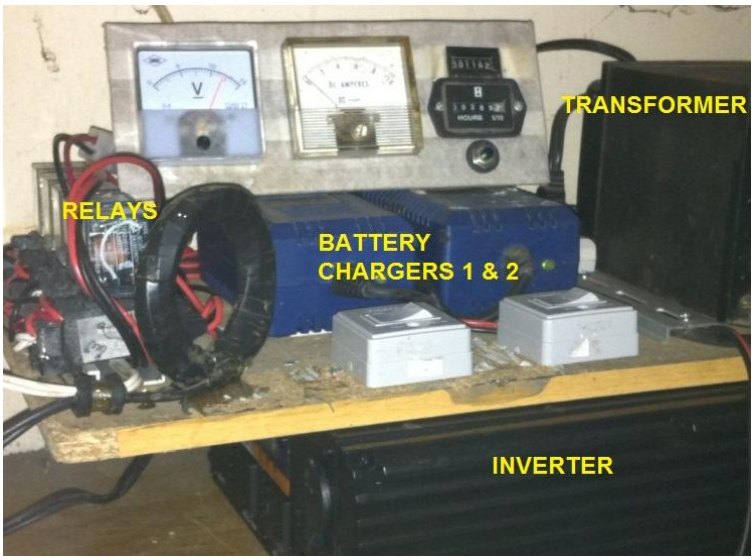
1. Utility power is ON so Plug 1 (line 6) maintains power to relay **A** (line 11).
2. This maintains NC contact **A** (line 39) open and keeps keeps OFF the emergency lights, elapsed time meter and counter.
3. Utility power from Plug 2 (line 87) energizes relay **D** (line 77) via closed contact **A** (line 77). Relay locks in on itself via contact **D** (line 81).
4. Open contact **D** (line 40) prevents interposing relay **B** (line 36) from energizing relays **C** (line 40) & **E** (line 44) because of open contact **B** (line 42).
5. Battery chargers 1 & 2 are running all the time and charges the battery, provided switches sw1 & sw2 (line 16) are closed. A one amp precision ammeter (line 27) measres charging rate, provided sw3 (line 25) is in correct position. Ammeter can overload if both chargers are on and battery is low.
6. A DC voltmeter (line 28) measures battery voltage all the time.
7. Heavy duty lines RED and BLACK (line 54) from battery are connected directly to inverter through a 0-60 ammeter (line 37), and knife sw (line 34) so inverter runs all the time, provided inverter sw (line 59) is closed.

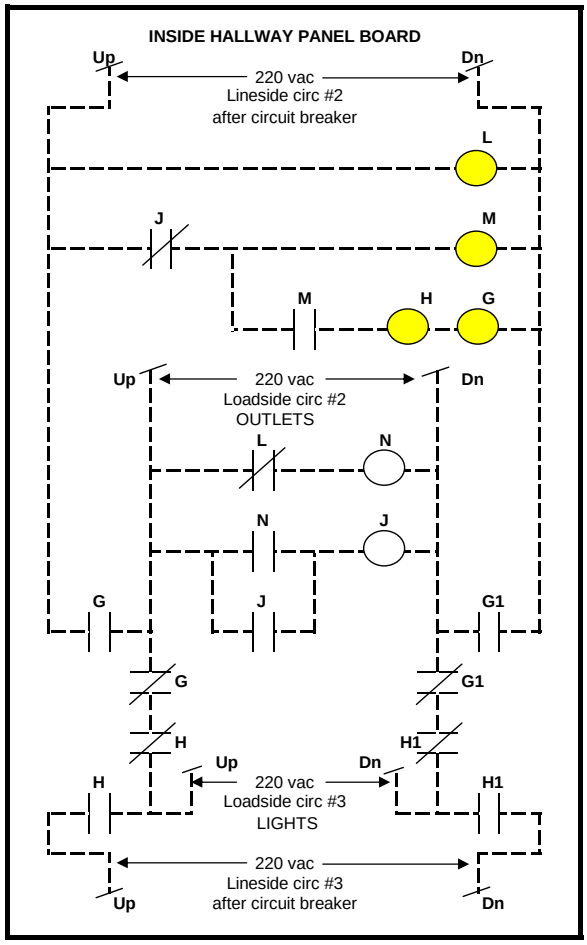
Scenario 2: BROWNOUT OCCURS

1. Power is lost to Plug 1 (line 6) and Plug 2 (line 85).
2. Relay **A** (line 12) de-energizes and contact **A** (line 40) closes, which starts emergency lights in kitchen (line 46), elapsed time meter starts running (line 49) and counter increments by another count (line 52).
3. Lost utillity power from Plug #2 causes relay **D** (line 77) to de-energize, opens contact **D** (line 81), unlocks the relay, and closes NC contact **D** (line 40).
4. With contacts **A** and **D** all closed, interposing relay **B** (line 36) energizes, and contact **B** (line 41) closes and energizes relay **C** (line 45) and relay **E** (line 44).
5. Contacts **C** (line 66) close, and feeds 110 vac to step-up transformer (line 70) through fuses (line 65).
6. Contacts **E** (line 77) close, and feeds 220 vac from transformer to plug 2 (line 85).
7. Relay **D** will not energize as it is locked out by open contact **A** (both line 77).

Scenario 3: BROWNOUT ENDS

1. Power is restored to Plug 1 (line 6)
2. Power will not be restored yet to plug 2 (line 85) due to lockout circuit in hallway panelboard.
3. Relay **A** (line 11) energizes, opening **A** contact (line39), thus shutting off emergency lights, elapsed time meter, etc. and de-enetrgizes interposing relay **B** (line 36).
4. Contact **B** (line 41) opens and de-energizes relay **C** (line 40) and relay **E** (line 43).
5. Contacts **C** (line 66) and contacts **E** (line 77) all open and isolates transformer and inverter from back feeding load side circ#2 via plug 2.
6. A few millisenconds later, power comes back via Plug 2 (line 85). Refer to Scenario 3 of Hallway Panel Board (line 122)
7. Relay **D** energizes, via closed contact **A** (both line 74), and locks in itself via **D** (line 81).
8. Condition is now back to Scenario 1 above.





Above ladder diagram shows interconnections of photo below.

AT PANEL BOARD IN HALLWAY

Scenario 1: NORMAL MODE

1. Lineside circ #2 (line 99) & circ #3 (line 139) has utility power. Relay **L** (line 103) is energized, and keeps NO contact **L** (line 118) open, locking out relays **N** & **J** (lines 118 & 122).
2. Relay **M** is energized via closed contact **J** (both line 107). Contact **M** (line 111) closes, and series-connected 110 vac relays **G** & **H** energize (line 111). Series coils **G** & **H** are for safety. If any coil fails, both relays de-energize.
3. NO contacts **G** & **G1** (line 126) close, & NC contacts **G** & **G1** (line 129) open, and NO contacts **H** & **H1** (line 135) close and NC contatcs **H** & **H1** (line 132) open, thus connecting the lineside to the loadside of circs #2 & #3.
4. Utility power goes into load side circ #2 (line 114), but cannot energize interposing relay **N** due to open contact **L** (both line 118), and consequently lockout relay **J** (line 122) remains de-energized. This relay will only energize when there is emergency power backfeeding from the inverter.

Scenario 2: BROWNOUT OCCURS

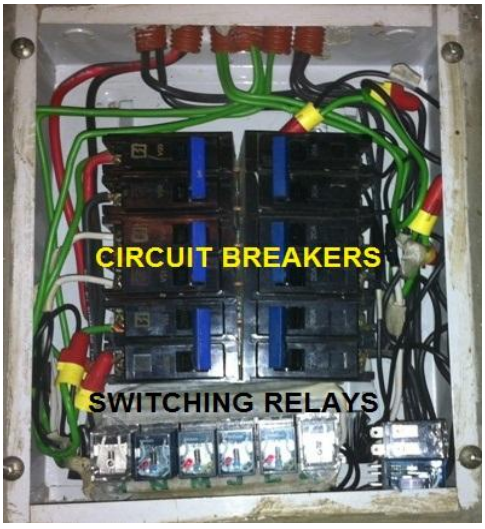
1. Power is lost to panel lineside circuits #2 (line 99) & #3 (line 139).
2. All relays de-energize, and loadside circ #2 & #3 is disconnected from respective line sides.
3. At the same time, loadside circ #2 & #3 are interconnected to one another via NC contacts **G** & **G1** (line 129) and **H** & **H1** (line 132).
4. A few milliseconds later, inverter power is backfed on loadside of circ #2, which also goes to circ #3.
5. Since NC contact **L** is closed, relay **N** will energize (both line 118), and contact **N** (line 122) will close and energize lock out relay **J** (line 122). Contact **J** (line 126) keeps **J** locked on.
6. This switching relays allow only 800 watts max load (lights & outlets) on inverter

Scenario 3: BROWNOUT ENDS

1. Power is restored to line sides of circ #2 (line 99) & #3 (line 139).
2. Relay **L** (line 103) energizes, opening contact **L**, thus de-energizing relay **N** (both line 118).
3. However, if inverter power still is being backfed to loadside circ #2, relay **J** (line 122) remains locked on and keeps contacts **J** (lines 107) open, preventing relays **M** (line 107), **G** & **H** (both line 111) from energizing.
4. As described in step 5, ATS Scenario 3 above, backfed power from inverter is interrupted. Relay **J** (line 122) is de-energized and unlocks itself.
5. Sequence progresses, same as steps 2 and 3 on Panel Board Scenario 1 above.
6. Condition is back to Scenario 1 normal mode.


means relay is enegized when in "normal" condition of having utility power

RELAYS	SPECS
A, D, M, L, J, N	220 vac, 2 pole 2 throw, 5 amp contact rating
B, C, E	12 vdc, 2 pole, 10 amp contact rating
G, H	110 vac, 2 pole, 2 throw, 10 amp contact rating



Top left: Hallway panelboard with circuit breakers and relays.
Top middle: Heavy duty battery in garage.
Bottom middle: Inverter on shelf in garage, under the wooden base with all the circuitry.
Top right: Wall outlets for Plug 1 & Plug 2 on upper shelf in garage. Note clamp-on ammeter and jumper cables for connection to car in case heavy duty battery runs low.
Bottom right: At other side of garage wall is the kitchen showing lower wall outlet where Plug 2 is connected, and that back feeds inverter power to house circuits #2 & #3. Upper wall outlet is new, reconnected to another house circuit for microwave, cooker, etc, which cannot be carried by inverter.

IN SUMMARY, THE LIGHTS, ELECTRIC FANS, TV, LAPTOPS AND INTERNET MODEM IN THE MASTER'S BEDROOM, KITCHEN, GUESTROOM, AND BOTH T&B WILL AUTOMATICALLY AND SEAMLESSLY STAY ON DURING BROWNOUTS, AND REVERT BACK TO HOUSE POWER WHEN BROWNOUT ENDS. DURATION AND FREQUENCY OF BROWN OUT IS AUTOMATICALLY LOGGED, AND BATTERY IS CHARGED.

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