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BSAS Macro: True Batch Processing From SAS EG Using Load Sharing Facility (LSF)

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ABSTRACT

The Centers for Medicare and Medicaid (CMS) Chronic Conditions Warehouse (CCW) Virtual Data Research Center (VRDC) is a large multi-user SAS Grid environment where most of the users are limited to SAS EG with no command line interface. LSF is a powerful true batch tool that allows a user to launch dozens of SAS jobs and then log out of environment but only from the command line interface. It is possible to make LSF batch available to EG-only users with adequate security using custom macros, script modifications, and SAS invocation options tied to Linux/Unix group membership.

INTRODUCTION

Many SAS users may be used to submitting from Base/PC SAS in batch mode and were surprised to not have a similar functionality in Enterprise Guide (EG). This paper aims to demonstrate how to add in that functionality using XCMD on a Linux SAS Grid using Load Sharing Facility (LSF). While this paper doesn't cover it, similar functionality can be replicated on a single-server, non-Grid environment.

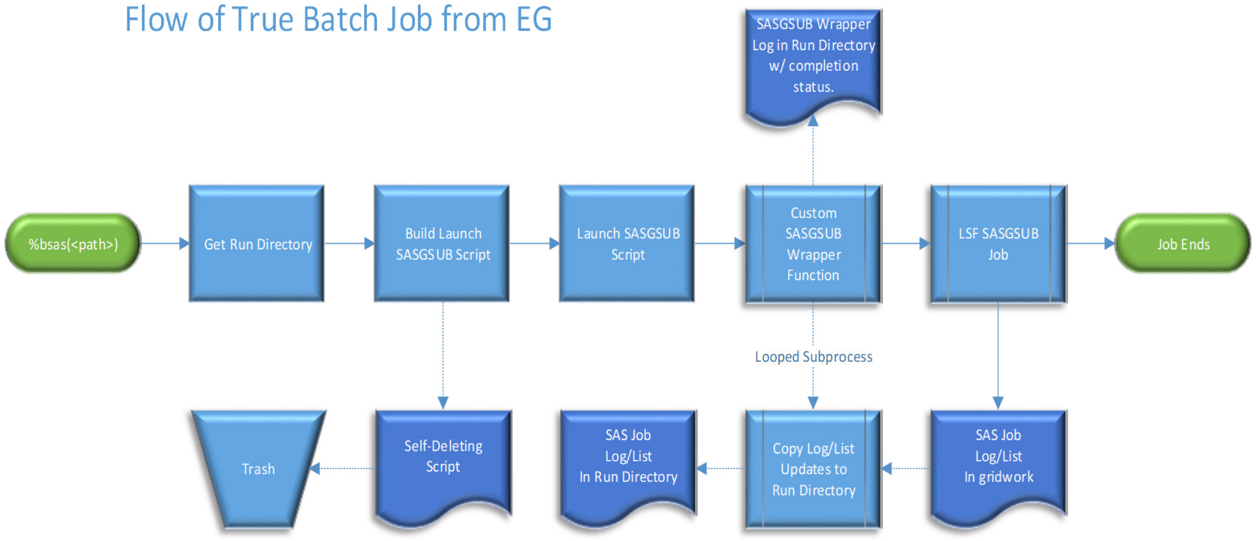
TRUE BATCH VS INTERACTIVE JOB ON LSF

What is a "True Batch Job"	SAS EG on LSF
➢ Not interactive.	❖ Interactive front end.
➢ Not child process of interactive process that launched it.	❖ Uses only one server grid as exec host by default.
➢ Completely independent of interactive process that launched it.	❖ Has background processes that are child processes of interactive session.
➢ I/O environment same as that of interactive process that launched it.	❖ Can leverage multiple servers on grid but only with complex SAS wrapper code. These are still not independent batch sessions. If the interactive parent session ends; so do the multiple grid job child sessions.

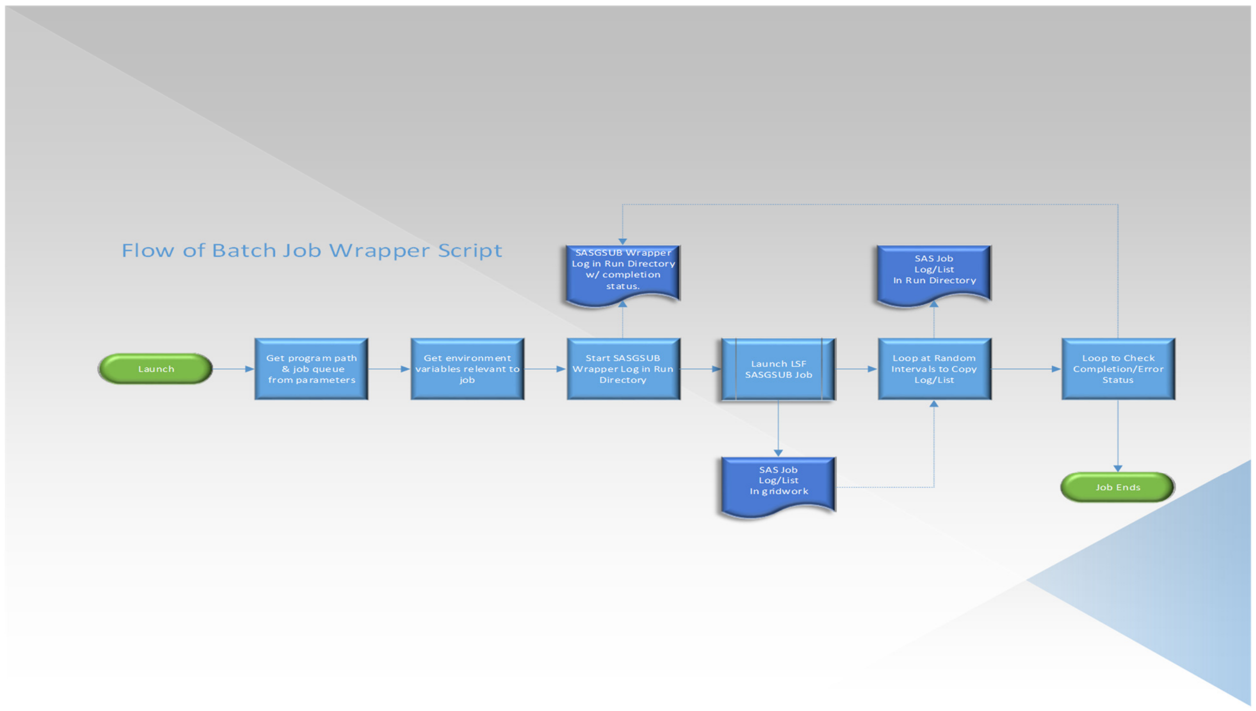
- ➢ SAS code is saved under file system available to EG.
- ➢ Batch job uses full Load Sharing Facility (LSF) grid capabilities.
- ➢ Batch job is completely independent of SAS EG session.
- ➢ Results of batch job are available in same directory as SAS program launched in batch.
- ➢ Depending on how EG environment is set up, no change in SAS code may be necessary to run job in batch.
- ➢ **Note: Any macro or script for true batch in EG will work identically on the command line.**

JOB FLOW

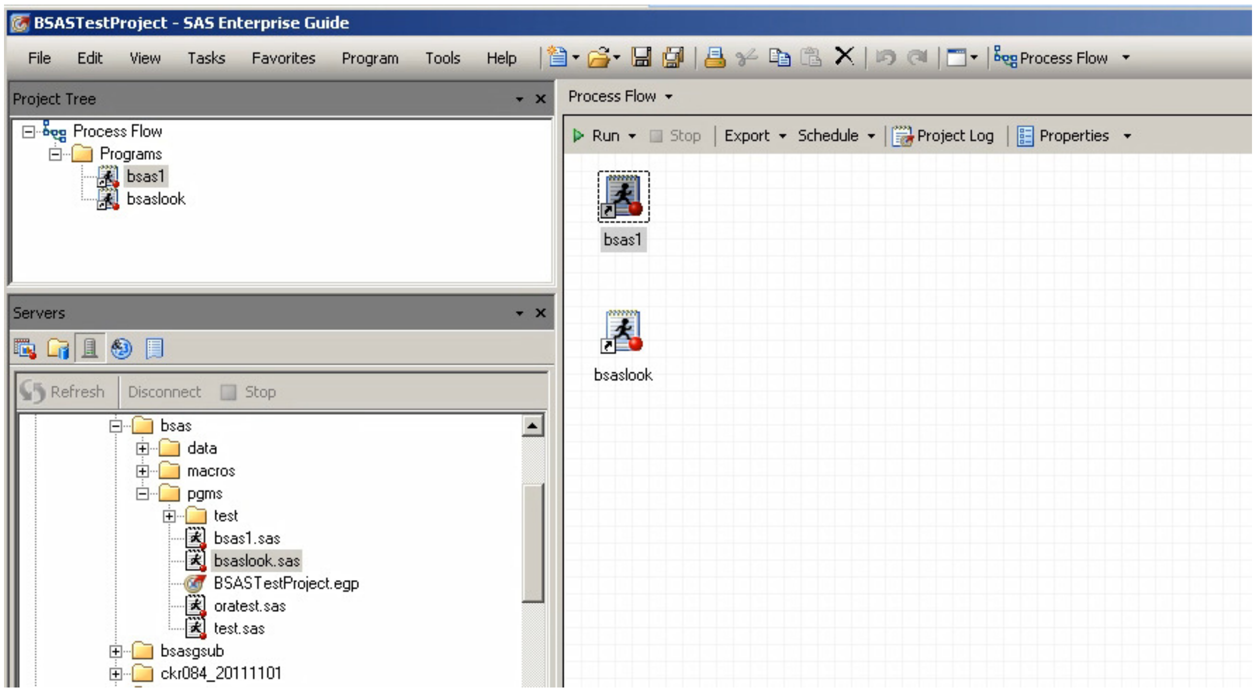
Flow of True Batch Job from EG

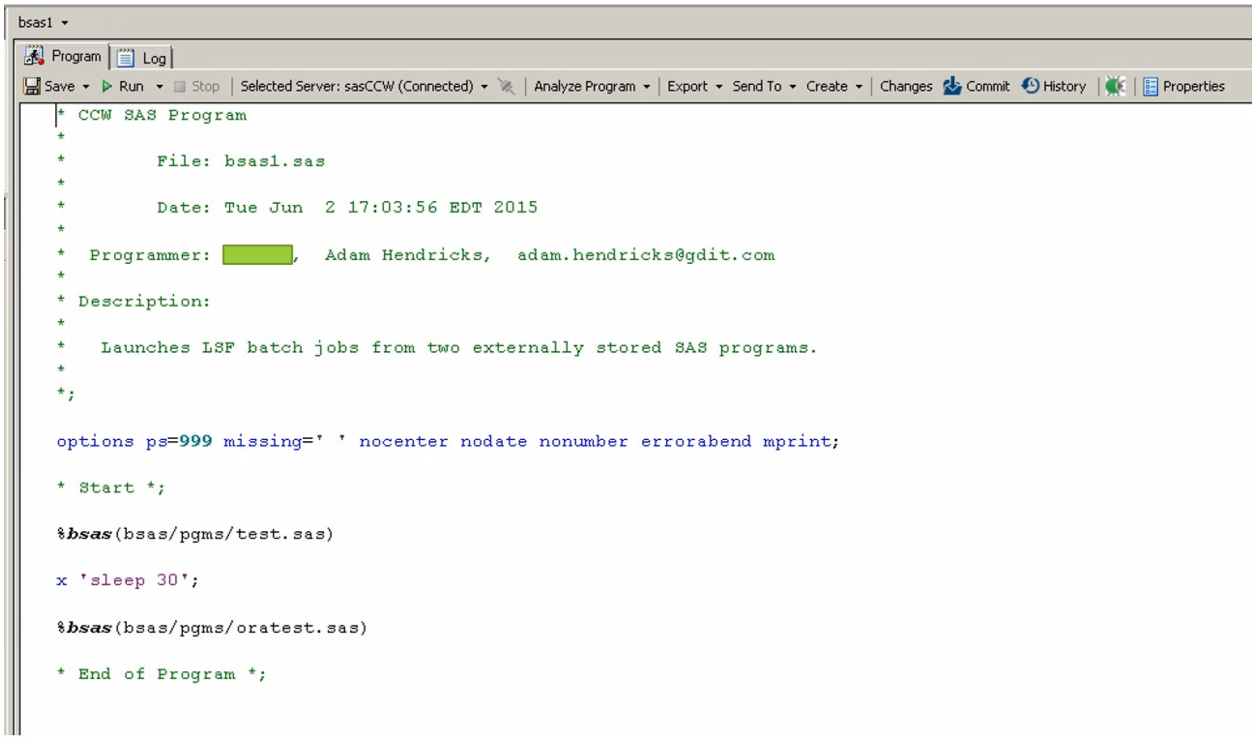


SASGSUB Wrapper Log in Run Directory w/ completion status.
%bsas(<path>)
Get Run Directory
Build Launch SASGSUB Script
Launch SASGSUB Script
Custom SASGSUB Wrapper Function
LSF SASGSUB Job
Job Ends
Looped Subprocess
Trash
Self-Deleting Script
SAS Job Log/List In Run Directory
Copy Log/List Updates to Run Directory
SAS Job Log/List In gridwork

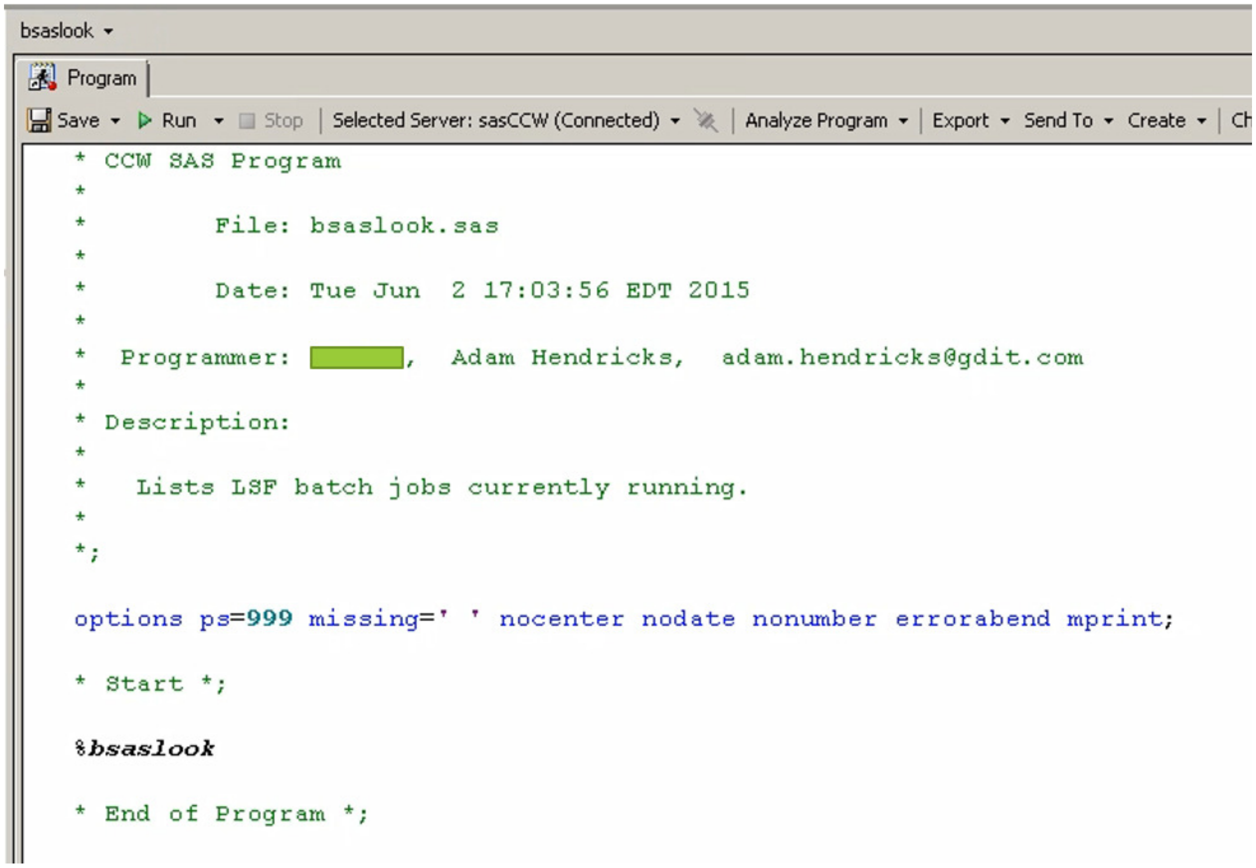


Flow of Batch Job Wrapper Script
SASGSUB Wrapper Log in Run Directory w/ completion status.
SAS Job Log/List In Run Directory
Launch
Get program path & job queue from parameters
Get environment variables relevant to job
Start SASGSUB Wrapper Log in Run Directory
Launch LSF SASGSUB Job
Loop at Random Intervals to Copy Log/List
Loop to Check Completion/Error Status
SAS Job Log/List In gridwork
Job Ends

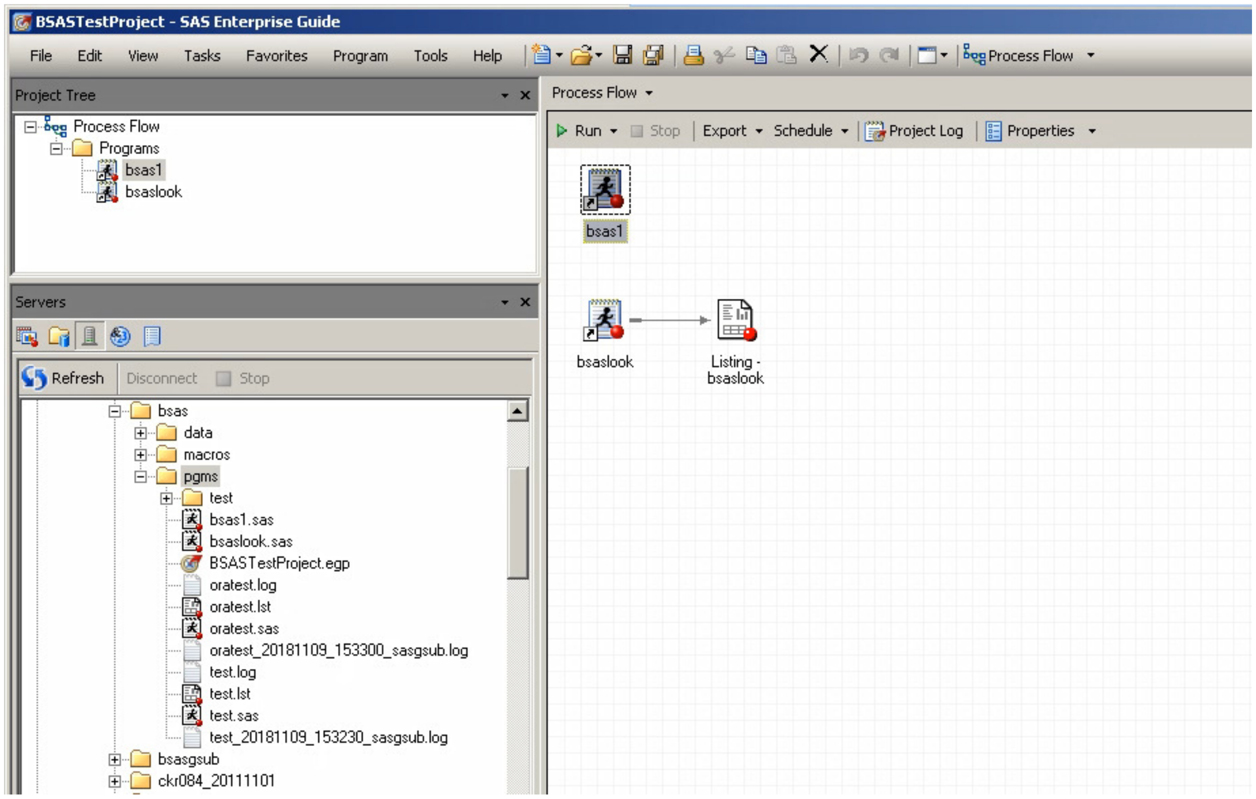


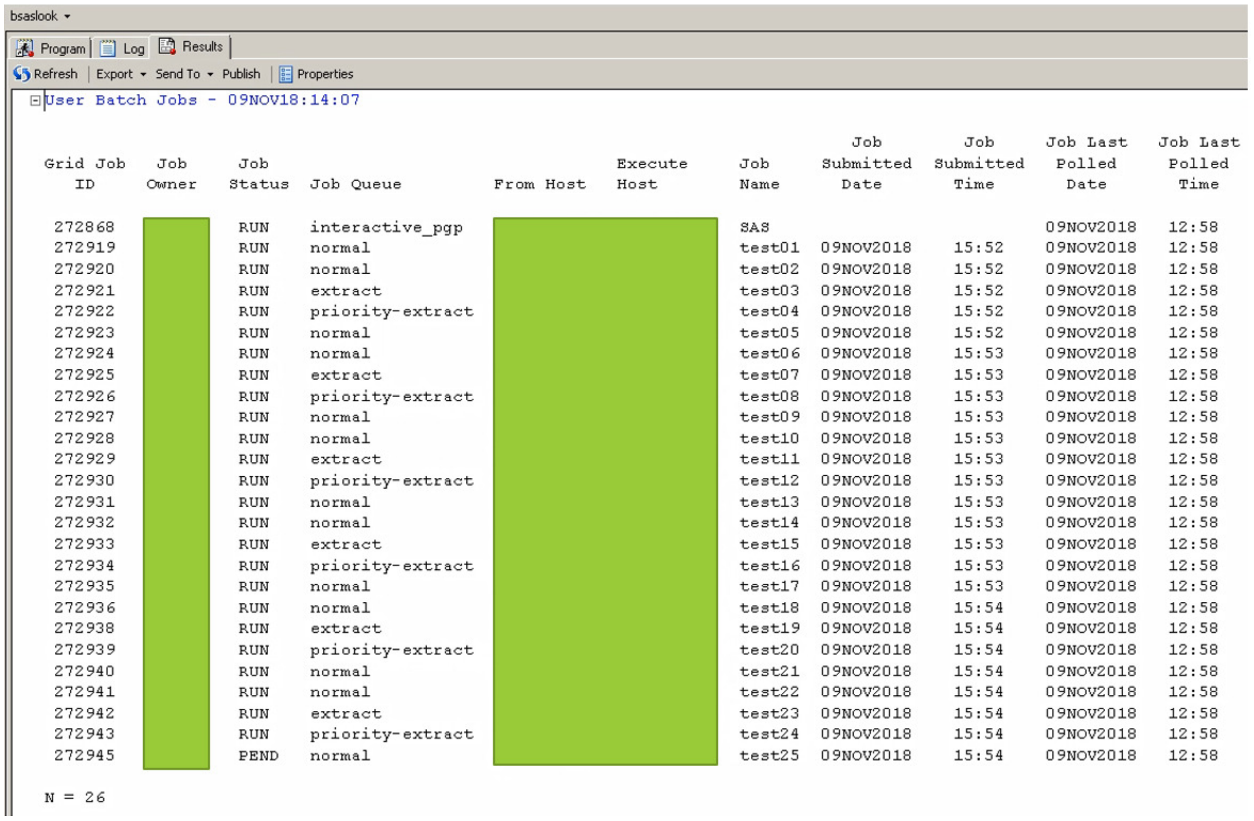

bsas1
Program Log
Save Run Stop Selected Server: sasCCW (Connected) Analyze Program Export Send To Create Changes Commit History Properties

```
* CCW SAS Program
*
*        File: bsas1.sas
*
*        Date: Tue Jun  2 17:03:56 EDT 2015
*
*  Programmer: [redacted],  Adam Hendricks,  adam.hendricks@gdit.com
*
* Description:
*
*   Launches LSF batch jobs from two externally stored SAS programs.
*
*;

options ps=999 missing=' ' nocenter nodate nonumber errorabend mprint;

* Start *;

%bsas(bsas/pgms/test.sas)

x 'sleep 30';

%bsas(bsas/pgms/oratest.sas)

* End of Program *;
```

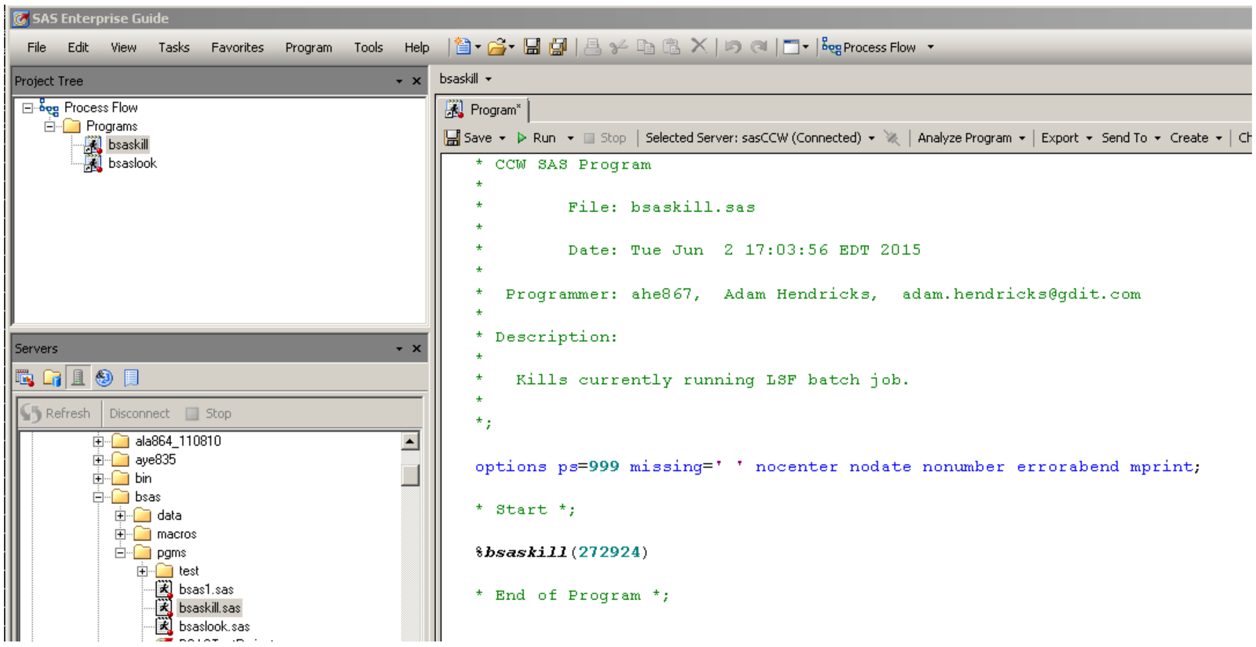


```
* CCW SAS Program
*
*         File: bsaslook.sas
*
*         Date: Tue Jun  2 17:03:56 EDT 2015
*
*  Programmer: [redacted],  Adam Hendricks,  adam.hendricks@gdit.com
*
* Description:
*
*   Lists LSF batch jobs currently running.
*
*;

options ps=999 missing=' ' nocenter nodate nonumber errorabend mprint;

* Start *;

%bsaslook

* End of Program *;
```





```
User Batch Jobs - 09NOV18:14:07

                                                                          Job        Job        Job Last   Job Last
 Grid Job    Job       Job                                   Execute  Job       Submitted  Submitted  Polled     Polled
    ID       Owner     Status  Job Queue          From Host   Host     Name      Date       Time       Date       Time

  272868   [redacted]  RUN    interactive_pgp    [redacted]           SAS                              09NOV2018  12:58
  272919   [redacted]  RUN    normal             [redacted]           test01    09NOV2018  15:52      09NOV2018  12:58
  272920   [redacted]  RUN    normal             [redacted]           test02    09NOV2018  15:52      09NOV2018  12:58
  272921   [redacted]  RUN    extract            [redacted]           test03    09NOV2018  15:52      09NOV2018  12:58
  272922   [redacted]  RUN    priority-extract   [redacted]           test04    09NOV2018  15:52      09NOV2018  12:58
  272923   [redacted]  RUN    normal             [redacted]           test05    09NOV2018  15:52      09NOV2018  12:58
  272924   [redacted]  RUN    normal             [redacted]           test06    09NOV2018  15:53      09NOV2018  12:58
  272925   [redacted]  RUN    extract            [redacted]           test07    09NOV2018  15:53      09NOV2018  12:58
  272926   [redacted]  RUN    priority-extract   [redacted]           test08    09NOV2018  15:53      09NOV2018  12:58
  272927   [redacted]  RUN    normal             [redacted]           test09    09NOV2018  15:53      09NOV2018  12:58
  272928   [redacted]  RUN    normal             [redacted]           test10    09NOV2018  15:53      09NOV2018  12:58
  272929   [redacted]  RUN    extract            [redacted]           test11    09NOV2018  15:53      09NOV2018  12:58
  272930   [redacted]  RUN    priority-extract   [redacted]           test12    09NOV2018  15:53      09NOV2018  12:58
  272931   [redacted]  RUN    normal             [redacted]           test13    09NOV2018  15:53      09NOV2018  12:58
  272932   [redacted]  RUN    normal             [redacted]           test14    09NOV2018  15:53      09NOV2018  12:58
  272933   [redacted]  RUN    extract            [redacted]           test15    09NOV2018  15:53      09NOV2018  12:58
  272934   [redacted]  RUN    priority-extract   [redacted]           test16    09NOV2018  15:53      09NOV2018  12:58
  272935   [redacted]  RUN    normal             [redacted]           test17    09NOV2018  15:53      09NOV2018  12:58
  272936   [redacted]  RUN    normal             [redacted]           test18    09NOV2018  15:54      09NOV2018  12:58
  272938   [redacted]  RUN    extract            [redacted]           test19    09NOV2018  15:54      09NOV2018  12:58
  272939   [redacted]  RUN    priority-extract   [redacted]           test20    09NOV2018  15:54      09NOV2018  12:58
  272940   [redacted]  RUN    normal             [redacted]           test21    09NOV2018  15:54      09NOV2018  12:58
  272941   [redacted]  RUN    normal             [redacted]           test22    09NOV2018  15:54      09NOV2018  12:58
  272942   [redacted]  RUN    extract            [redacted]           test23    09NOV2018  15:54      09NOV2018  12:58
  272943   [redacted]  RUN    priority-extract   [redacted]           test24    09NOV2018  15:54      09NOV2018  12:58
  272945   [redacted]  PEND   normal             [redacted]           test25    09NOV2018  15:54      09NOV2018  12:58

 N = 26
```



```
* CCW SAS Program
*
*        File: bsaskill.sas
*
*        Date: Tue Jun  2 17:03:56 EDT 2015
*
*  Programmer: ahe867,  Adam Hendricks,  adam.hendricks@gdit.com
*
* Description:
*
*   Kills currently running LSF batch job.
*
*;

options ps=999 missing=' ' nocenter nodate nonumber errorabend mprint;

* Start *;

%bsaskill(272924)

* End of Program *;
```

CONFIGURATION AND CODE EXAMPLES

Second grid metadata server with XCMD turned on or sasgrid & WorkspacesServer.sh script edited to give XCMD capability to users approved for true batch processing.

Example of WorkspaceServer.sh modification:

```
cmd="$SAS_COMMAND $USERMODS_OPTIONS"
arg='-noxcmd'
batch_group_found=`/usr/bin/groups $USER | grep 'sas_batch' | wc -l`

if [[ $batch_group_found -ne 0 ]]
then
  arg="-xcmd"
fi
cmd="$cmd $arg"
```

- Get Run Directory and SAS Code Path to Global Macrovariables
  - Call by system autoexec.sas

```
%macro pgmpath;
  %global pwd cwd pgm;
  %let pwd = %sysget(PWD);
  %let cwd = %sysget(LS_SUBCWD);

  %if %superq(cwd) =
  %then %let cwd = &pwd.;
  %else %let pwd = &cwd.;

  %put pwd=&pwd. cwd=&cwd.;

  proc sql noprint;
    select scan(xpath,-1,'/')
      into :pgm
      from sashelp.vextfl
     where upcase(xpath) like '%.SAS';
  quit;

  %let pgm = %trim(&pgm.);
  %put pgm=&pgm.;
  %put pgmpath=&pwd./&pgm.;
%mend;

%pgmpath
```

- Macros for Launching Batch Job

```
%macro bsas_sched(pgm=,waithr=0,waitmin=0);
%let uid = %sysget(LOGNAME);

data _null_;
  length dirname pgm $200 waitsec 8;
  dirname  = compress("&user_dirs./&uid./files");
  pgm      = compress(dirname||"/&pgm.");
  pgm      = strip(reverse(pgm));
  dirstrt  = index(pgm,'/') + 1;
  dirname  = strip(reverse(substr(pgm,dirstrt)));
  pgm      = strip(reverse(scan(pgm,1,'/')));

  * Timestamps *;
  ccyymmdd = put(today(),yymmddn8.);
  hhmmss   = compress(translate(put(time(),time.),' ',':'));
  ccyymmddhhmmss = compress(ccyymmdd||hhmmss);

  * Wait Time *;
  waithr   = max(&waithr.,0);
  waitmin  = &waitmin.;
  waitsec  = waithr*60*60 + waitmin*60;

  * Extension Name *;
  ext = scan(left(reverse(pgm)),1,'.');

  put ext=;

  pgmnm = scan(pgm,1,'.');

  put pgmnm=;

  if ext eq 'sas'
  then pgm = scan(pgm,1,'.');

  put pgm=;

  callfile = compress(dirname||"/bsasgsub_&uid._"||pgmnm||'_'||ccyymmddhhmmss||'.sh');

  call symput('dirname',strip(dirname));
  call symput('callfile',strip(callfile));
  call symput('pgm',pgm);
  call symput('waitsec',strip(left(waitsec)));

  put dirname=;
  put pgm=;
  put callfile=;
run;

filename bsasgsub "%trim(&callfile.)";

data _null_;
  file bsasgsub noprint;
  put '#!/bin/ksh';
  put '#';
  put ' ';
  put ". &profile_dir./sas_user_profile.sh > /dev/null";
  put ' ';
  put "cd %trim(&dirname.)";
  put ' ';

%if &waitsec gt 0
%then put "sleep &waitsec.";;

  put "sasgsub_launch.sh %trim(&pgm.) &";
  put ' ';
  put 'sleep 5';
  put ' ';
  put "/bin/rm -f %trim(&callfile.)";
  put ' ';
  put '#';
  put '# End of Script';
run;

filename bsasgsub clear;

x "chmod 740 %trim(&callfile.)";
x "nohup %trim(&callfile.) > /dev/null 2>&1 &";
%mend;

%macro bsas(pgm);
  %bsas_sched(pgm=&pgm.)
%mend;
```

- Macro to List LSF Batch Jobs Running or Pending

```
%macro bsaslook;
* bjobs command in wide tab-delimited format *;
filename bjobs pipe "bjobs -w | &tools_dir./mktab";

* Start *;
data __bjobs;
  length jobid 8 user $8 status $10 queue $20 from_host exec_host job_name $40 mon $3 dd
$2 time $5
         submit_date 4 submit_time 8 last_poll_date 4 last_poll_time runtime 8;

  format submit_date last_poll_date date9. submit_time last_poll_time time5. runtime
hhmm12.;

  label jobid          = 'Grid Job ID'
        user           = 'Job Owner'
        status         = 'Job Status'
        queue          = 'Job Queue'
        from_host      = 'From Host'
        exec_host      = 'Execute Host'
        job_name       = 'Job Name'
        submit_date    = 'Job Submitted Date'
        submit_time    = 'Job Submitted Time'
        last_poll_date = 'Job Last Polled Date'
        last_poll_time = 'Job Last Polled Time'
        runtime        = 'Job Run Time HH:MM';


  infile bjobs dlm='09'x dsd firstobs=2;
  input jobid user $ status $ queue $ from_host $ exec_host $ job_name $ mon $ dd $ time
$;

  if queue ne 'priority';

  from_host      = scan(from_host,1,'.');
  exec_host      = scan(exec_host,1,'.');
  submit_date    = input(compress(dd||mon||put(year(date()),4.)),date9.) ;
  submit_time    = input(time,time.);
  last_poll_date = date();
  last_poll_time = time();
  start          = dhms(submit_date,hour(submit_time),minute(submit_time),0);
  end            = dhms(last_poll_date,hour(last_poll_time),minute(last_poll_time),0);
  runtime        = end - start;

  drop mon dd time start end;
run;

proc sort data=__bjobs;
  by jobid;
run;

proc print data=__bjobs noobs n width=minimum label;
  title "User Batch Jobs - &sysdate.:&systime.";
run;

proc sql;
  drop table __bjobs;
quit;
%mend;
```

- Macro to Kill LSF Batch Job

```
%macro bsaskill(jobid);
%let uid = %sysget(LOGNAME);

data _null_;
  length dirname $200;
  dirname  = compress("&users_dir./&uid./files");
  jobid    = strip("&jobid.");
  ccyymmdd = put(today(),yymmddn8.);
  hhmmss   = compress(translate(put(time(),time.),' ',':'));
  ccyymmddhhmmss = compress(ccyymmdd||hhmmss);

  callfile =
compress(dirname||"/bsasgsub_kill_&uid._"||jobid||'_'||ccyymmddhhmmss||'.sh');

  call symput('dirname',strip(dirname));
  call symput('callfile',strip(callfile));

  put dirname=;
  put jobid=;
  put callfile=;
run;

filename bsasgsub "%trim(&callfile.)";

data _null_;
  file bsasgsub noprint;
  put '#!/bin/ksh';
  put '#';
  put ' ';
  put ". &profile_dir./sas_user_profile.sh > /dev/null";
  put ' ';
  put "bkill %trim(&jobid.) > /dev/null 2>&1";
  put 'sleep 5';
  put "/bin/rm -f %trim(&callfile.)";
  put ' ';
  put '#';
  put '# End of Script';
run;

filename bsasgsub clear;

x "chmod 740 %trim(&callfile.)";
x "%trim(&callfile.)";
%mend;
```

- Wrapper Script

```
#!/bin/ksh
#
# File: sasgsub_launch.sh
#
# Purpose: Wrapper Script for SASGSUB call.
#
# Parameters: saspgmpath - SAS Program Path
#

# Get SAS Program Path and Login ID
#
saspgmpath=$1                                              # <-- Input SAS program path,
literal or relative
gridqueue=$2                                               # <-- Grid Queue, NULL
(defaults to normal), normal, extract, or priority-extract.
wrapper_pid=$$                                             # <-- Unix PID of this
process.
sasgriduser=${LOGNAME}

if [[ ${gridqueue} == "" ]]
then
  gridqueue="normal"
fi

# Check if Current Location is Writetable
#
echo "test" > tmp$$.txt
status=$?

if (( $status != 0 ))
then
  echo "Error: Current Directory is Not Writable by User.  Exiting..."
  exit
else
  /bin/rm -f tmp$$.txt
fi

# Get SAS Program Dir Path
#
saspgmdir=`dirname ${saspgmpath}`                          # <-- Directory of input SAS
program

# Get server ID job on which this script was called.
#
NODE=`hostname`

# Give literal path if program path and start directory are same.
#
if [[ ${saspgmdir} == '.' ]]
then
  saspgmdir=`pwd`
fi

# Allow for omission of '.sas' extension in SAS program path.
#
if [ -f ${saspgmpath} ]
then
  echo " " > /dev/null  # Do Nothing
else
  saspgmpath="${saspgmpath}.sas"
fi

# Generate Run Parameter Strings
#
saspgm=`basename ${saspgmpath}`                            # <-- Input SAS program name
startdir=`pwd`                                             # <-- Directory where
sasgsub_launch.sh called.
```

```
dt_str=`date '+%Y%m%d_%H%M%S'`                              # <-- Date string for sasgsub
job log
sasprefix=`echo "${saspgm}" | cut -f 1 -d .`                # <-- Get prefix of SAS
program for log/lst names.
saspgm="${sasprefix}.sas"                                   # <-- Define standard SAS
program extension.
saslog="${sasprefix}.log"                                   # <-- Define SAS log name.
saslst="${sasprefix}.lst"                                   # <-- Define SAS log name.
sasgsublog="${startdir}/${sasprefix}_${dt_str}_sasgsub.log" # <-- SASGSUB job log
statuslog="${startdir}/${sasprefix}_${dt_str}_status.log"   # <-- SASGSUB temporary
status log

# Change to Start Directory
#
cd ${startdir}

# Start SASGSUB Job Log
#
echo "-- SASGSUB Launch --"         > ${sasgsublog}
echo " "                             >> ${sasgsublog}
echo "       This Log: ${sasgsublog}"  >> ${sasgsublog}
echo "Start Date/Time: `date`"         >> ${sasgsublog}
echo "           User: ${LOGNAME}"     >> ${sasgsublog}
echo "Start Directory: ${startdir}"    >> ${sasgsublog}
echo "     Start Host: ${NODE}"        >> ${sasgsublog}
echo "    Wrapper PID: ${wrapper_pid}" >> ${sasgsublog}
echo "     Grid Queue: ${gridqueue}"   >> ${sasgsublog}
echo " "                               >> ${sasgsublog}
echo "------------------------"        >> ${sasgsublog}

# Error Out if Bad Queue Entered
#
if [[ ${gridqueue} != "normal" && ${gridqueue} != "extract" && ${gridqueue} != "priority-
extract" && ${gridqueue} != "workbench" && ${gridqueue} != "normal_rerunnable" &&
${gridqu
eue} != "pgp" && ${gridqueue} != "support_users" ]]
then
  echo " "
>> ${sasgsublog}
  echo "ERROR: Invalid grid queue entered (${gridqueue}).  Job not submitted."
>> ${sasgsublog}
  echo " "
>> ${sasgsublog}
  echo "NOTE: Valid queue choices are NULL (defaults to normal), normal, extract, or
priority-extract." >> ${sasgsublog}
  echo " "
>> ${sasgsublog}
  echo "End Date/Time: `date`"
>> ${sasgsublog}
  echo " "
>> ${sasgsublog}
  echo "--- End of SASGSUB Log"
>> ${sasgsublog}
  exit
fi

# If input path exists, launch job, else error out.
#
if [ -f ${saspgmpath} ]
then
  sasgsub.sh -GRIDCONFIG ${sas_config_path}/sasgsub.cfg -GRIDSUBMITPGM ${saspgmpath} -
GRIDJOBOPTS queue=${gridqueue} -GRIDUSE
R ${sasgriduser} >> ${sasgsublog}
else
  echo " "                                                                          >>
${sasgsublog}
  echo "ERROR: Input path (${saspgmpath}) does not exist.  Exiting SASGSUB launch." >>
${sasgsublog}
  echo " "                                                                          >>
${sasgsublog}
```

```
  echo "End Date/Time: `date`"                                                    >>
${sasgsublog}
  echo " "                                                                        >>
${sasgsublog}
  echo "--- End of SASGSUB Log"                                                   >>
${sasgsublog}
  exit
fi

# Get Job ID and Directory from launch messages.
#
job_id=`grep 'Job ID:' ${sasgsublog} | cut -f 2 -d :`
job_id=`printf "%-10s" ${job_id}`
job_id=`echo $job_id | awk '{ print $1 }'`
job_dir=`grep 'Job directory:' ${sasgsublog} | cut -f 2 -d : | tr -d \"`
job_dir=`printf "%-90s" ${job_dir}`
job_dir=`echo $job_dir | awk '{ print $1 }'`
job_status="Submitted"

# If Job ID not retrieved, then exit with error.
#
if [[ ${job_id} == '' ]]
then
  echo " "                                                                        >>
${sasgsublog}
  echo "ERROR: Grid Job ID not ascertained.  Exiting SASGSUB launch."             >>
${sasgsublog}
  echo " "                                                                        >>
${sasgsublog}
  echo "End Date/Time: `date`"                                                    >>
${sasgsublog}
  echo " "                                                                        >>
${sasgsublog}
  echo "--- End of SASGSUB Log"                                                   >>
${sasgsublog}
  echo "sasgsub.sh -GRIDCONFIG ${sas_config_path}/sasgsub.cfg -GRIDSUBMITPGM
${saspgmpath} -GRIDJOBOPTS queue=${gridqueue} -G
RIDUSER ${sasgriduser}"  >> ${sasgsublog}
  exit
fi

# Append job specifics to SASGSUB job log
#
echo " "                                        >> ${sasgsublog}
echo "               Job ID: ${job_id}"          >> ${sasgsublog}
echo "        Job Directory: ${job_dir}"         >> ${sasgsublog}
echo "           Job Status: ${job_status}"      >> ${sasgsublog}
echo "      Start Directory: ${startdir}"        >> ${sasgsublog}
echo "SAS Program Directory: ${saspgmdir}"       >> ${sasgsublog}
echo "          SAS Program: ${saspgm}"          >> ${sasgsublog}
echo "              SAS Log: ${saslog}"          >> ${sasgsublog}
echo "             SAS List: ${saslst}"          >> ${sasgsublog}
echo " "                                        >> ${sasgsublog}

sleep 20   # <-- Sleep 20 seconds to give Running status time to come up.

acquired_server=0  # <-- Acquired Run Server ID Boolean Established as False
crash_counter=0    # <-- Crash Counter to Prevent False Crash Message

# Check job every minute for status. Close out loop when done.
#
while [[ ${job_status} != 'Finished' && ${job_status} != 'Failed' ]]
do
  sasgsub.sh -GRIDCONFIG ${sas_config_path}/sasgsub.cfg -GRIDGETSTATUS ${job_id} >
${statuslog}  # <-- Run job status. Output
 to job log.

  # Update job status variable from new status log.
  #
  submitted=`grep 'is Submitted:' ${statuslog} | wc -l`
  running=`grep 'is Running:' ${statuslog} | wc -l`
  finished=`grep 'is Finished:' ${statuslog} | wc -l`
  failed=`grep 'has Failed:' ${statuslog} | wc -l`

  /bin/rm -f ${statuslog} # <-- Delete temporary status log file.

  if (( ${running} == 1 ))
  then
    job_status="Running"
  elif (( ${finished} == 1 ))
  then
    job_status="Finished"
  elif (( ${failed} == 1 ))
  then
    job_status="Failed"
  elif (( ${submitted} == 1 ))
  then
    job_status="Submitted"
  fi

  #
  # Exits this script when orphaned from grid job.
  #
  job_running=`bjobs 2>&1 | grep ${job_id} | wc -l`

  if (( ${job_running} == 0 && ${running} == 1 ))
  then
      if (( ${crash_counter} > 0 ))  # Two cycles of fail test positive required for
Failed message.
      then
        echo "Error: Job appears to have crashed.  Exiting..." >> ${sasgsublog}
        echo " "                                               >> ${sasgsublog}
        job_status="Failed"
      fi

    (( crash_counter=${crash_counter}+1 ))
  elif (( ${job_running} == 0 && ${submitted} == 1 ))
  then
    echo "Error: Job appears to have been cancelled.  Exiting..." >> ${sasgsublog}
    echo " "                                                      >> ${sasgsublog}
    job_status="Failed"
  fi

  # Acquire ID of server on which job is running.
  #
  if (( ${running} == 1 && ${acquired_server} == 0 ))
  then
    run_server=`bjobs 2>&1 | grep ${job_id} | /sas/scripts/common_tools/mktab | cut -f 6
| cut -f 1 -d .`
    acquired_server=1   # <-- Acquired Run Server ID Boolean Set True

    echo " "                            >> ${sasgsublog}
    echo "Job Run Server: ${run_server}" >> ${sasgsublog}
    echo " "                            >> ${sasgsublog}
  fi

  # Left Just and Trim Job Status
  #
  job_status=`printf "%-20s" ${job_status}`
  job_status=`echo $job_status | awk '{ print $1 }'`

  # Convert Failed status caused by mere warnings to Finished
  #
  if [[ ${job_status} == 'Failed' ]]
  then
    /bin/cp ${job_dir}/${sasprefix}.l* ${startdir}  # <-- Move SAS Log/List files to
start directory.
    errors=`grep ERROR: ${startdir}/${saslog} | grep -v CCW | head -1 | wc -l`
    endofsaslog=`grep "NOTE: SAS Institute Inc., SAS Campus Drive, Cary, NC USA 27513-
2414 " ${startdir}/${saslog} | wc -l`

    if (( ${errors} == 0 )) && (( ${endofsaslog} == 1 ))
    then
      job_status="Finished"
    fi
  fi

  # Append current status to job log.
  #
  echo "`date` - Job Status: ${job_status}" >> ${sasgsublog}

  # Get Current SAS Log and List and Keep Running
  #
  if [[ ${job_status} != 'Finished' && ${job_status} != 'Failed' ]]
  then
    /bin/cp ${job_dir}/${sasprefix}.l* ${startdir}  # <-- Move SAS Log/List files to
start directory.
    sleep_sec=$(((RANDOM%30+120))) # <-- Random number between 120 and 150
    sleep ${sleep_sec}             # <-- Sleep randomly between 1 and 2 minutes
  fi
done

# Close Out Finished Job.  Delete Temp. Status Log and Copy Log/List to Current
Directory.
#
/bin/rm -f ${statuslog}                            # <-- Delete temporary status log
file.
/bin/cp ${job_dir}/${sasprefix}.l* ${startdir}     # <-- Move SAS Log/List files to start
directory.
chmod 660 ${startdir}/${sasprefix}.l*

#/bin/rm -rf ${job_dir}                            # <-- Delete SASGSUB job work
directory.

# Look Errors, Warnings, and Uninitialized messages in SAS log.
#
errors=`grep ERROR: ${startdir}/${saslog} | grep -v CCW | head -1`
warnings=`grep WARNING: ${startdir}/${saslog} | head -1`
uninitialized=`grep uninitial ${startdir}/${saslog} | head -1`

# Close out SASGSUB job log
#
echo " "                     >> ${sasgsublog}
echo "-- Results --"         >> ${sasgsublog}
echo " "                     >> ${sasgsublog}
ls -l ${startdir}/${saslog}   >> ${sasgsublog}  # <-- List new SAS log file to SASGSUB
log.

if [ -f ${startdir}/${saslst} ]
then
  ls -l ${startdir}/${saslst} >> ${sasgsublog}  # <-- List new SAS list file to SASGSUB
log.
fi

# Note that errors were found in SAS log.
#
if [[ ${errors} != '' ]]
then
  echo " "                                 >> ${sasgsublog}
  echo "Errors found in ${startdir}/${saslog}" >> ${sasgsublog}
fi

# Note that warnings were found in SAS log.
#
if [[ ${warnings} != '' ]]
then
  echo " "                                   >> ${sasgsublog}
  echo "Warnings found in ${startdir}/${saslog}" >> ${sasgsublog}
fi

# Note that uninitialized messages were found in SAS log.
#
if [[ ${uninitialized} != '' ]]
```

```
then
  echo " "                                                    >> ${sasgsublog}
  echo "Uninitialized messages found in ${startdir}/${saslog}" >> ${sasgsublog}
fi

# End of Job Log
#
echo " "                      >> ${sasgsublog}
echo "End Date/Time: `date`"  >> ${sasgsublog}  # <-- Append end date/time to job log.
echo " "                      >> ${sasgsublog}
echo "--- End of SASGSUB Log" >> ${sasgsublog}

#
# End of Script
```

- SASGSUB Log Example from Wrapper Script

```
-- CCW SASGSUB Launch --

       This Log: xxxxxx: gridtest/test25_20181028_173021_sasgsub.log
Start Date/Time: Sun Oct 28 17:30:21 EDT 2018
           User: xxxxxx
Start Directory: gridtest
     Start Host: sasgrid04
    Wrapper PID: 19580
     Grid Queue: normal

------------------------

SAS Grid Manager Client Utility Version 9.45 (build date: Oct  3 2017)
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Job <258221> is submitted to queue <normal>.
Job ID:         258221
Job directory: "/sas/grid-work/xxxxxx/SASGSUB-2018-10-28_17.30.22.096_test25"
Job log file:  "/sas/grid-work/xxxxxx/SASGSUB-2018-10-28_17.30.22.096_test25/test25.log"

               Job ID: 258221
        Job Directory: /sas/grid-work/xxxxxx/SASGSUB-2018-10-28_17.30.22.096_test25
           Job Status: Submitted
      Start Directory: gridtest
SAS Program Directory: gridtest
          SAS Program: test25.sas
              SAS Log: test25.log
             SAS List: test25.lst

Sun Oct 28 17:32:01 EDT 2018 - Job Status: Submitted
Sun Oct 28 17:35:35 EDT 2018 - Job Status: Submitted
Sun Oct 28 17:39:25 EDT 2018 - Job Status: Submitted
Sun Oct 28 17:42:11 EDT 2018 - Job Status: Submitted

Job Run Server: sasgrid13

Sun Oct 28 17:45:29 EDT 2018 - Job Status: Running
Sun Oct 28 17:49:05 EDT 2018 - Job Status: Running
Sun Oct 28 17:52:37 EDT 2018 - Job Status: Running
Sun Oct 28 17:56:07 EDT 2018 - Job Status: Finished

-- Results --

-rw-rw---- 1 xxxxxx sas_usr 73216 Oct 28 17:56 gridtest/test25.log
-rw-rw---- 1 xxxxxx sas_usr 11283 Oct 28 17:56 gridtest/test25.lst
```

```
Errors found in gridtest/test25.log

End Date/Time: Sun Oct 28 17:56:07 EDT 2018

--- End of SASGSUB Log
```

CONCLUSION

Whether your environment has SAS Grid or not, you too can have a batch submission capability within Enterprise Guide (EG).

CONTACT INFORMATION

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